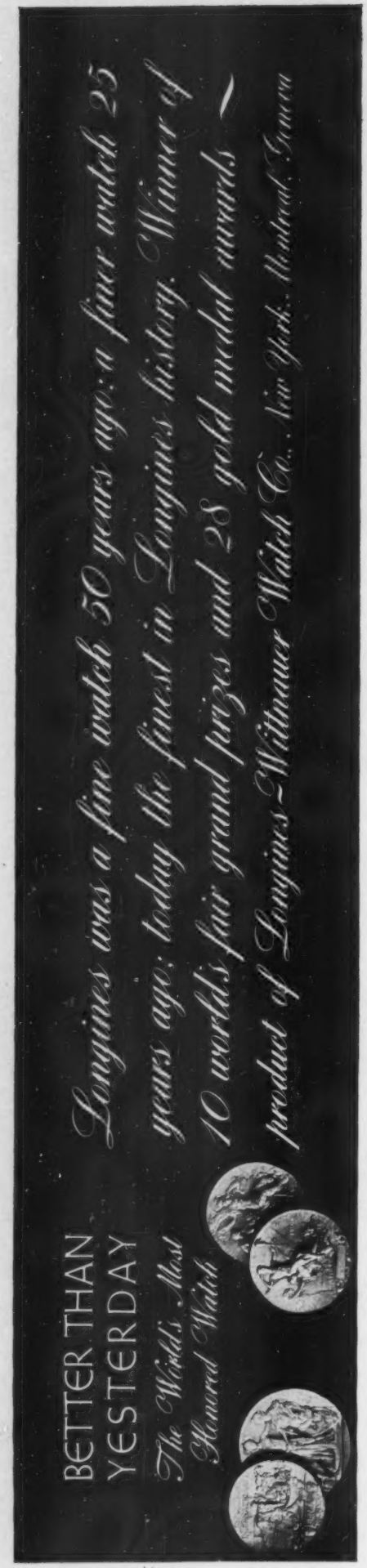
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Sky and TELESCOPE

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The Editors Note . . .

HIGHLIGHT of our editorial experiences within the month was the witnessing of a demonstration of the new one-minute start-to-finish camera invented by Edwin H. Land, president and director of research of Polaroid Corporation here in Cambridge, Mass. The new process, which has received no more publicity than it deserves, is as revolutionary as any improvement which has occurred since the invention of photography itself. In a few years, it should work a change of great significance in nearly every process, industrial, commercial, scientific, where photography is used, possibly even in astronomy.

Realizing the vast potentialities of the new now-you-take-it, now-you-see-it process for amateur photography, which is probably our greatest peacetime hobby, Polaroid has concentrated on perfecting a method of producing a positive print in from 40 to 50 seconds after the camera is snapped, regardless of the size or type of camera and the conditions of taking the picture. Nothing else has been changed — the amateur can still fuss and fume as much as he pleases while setting the camera — his success or failure is definitely known within the minute, and the positive picture is permanent and of high quality.

The Land photographic sandwich is the secret of the process, apparently so simple one wonders why it was not thought of earlier. But several chemical principles are applied with extreme precision in replacing the dozen or so steps from developer to finished print with one simple turn of a knob. One type of camera used in the demonstrations contains a pair of small rollers, and a place for a roll of special paper in addition to the usual roll of film. Otherwise it is like an ordinary roll-film camera. After the picture is taken, a turn of a knob on the side of the camera advances the film and paper together out of the camera and through the rollers. Film and paper are pressed together into a temporary sandwich by the pressure of the rollers. When they are peeled apart, 40 to 50 seconds later, the paper carries on it, practically dry, the finished picture.

When the sandwich of paper and film passes through the rollers, the pressure breaks a small sealed pod attached to the

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APRIL, 1947

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BACK COVER: A portion of the moon near last quarter, from a Lick Observatory photograph taken with the 36-inch refractor by J. H. Moore and J. F. Chappell. This is Plate XIII in the series. (See In Focus.)

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HALL OF EARTH, AIR, AND SKY

of the Polytechnic Institute of Puerto Rico

BY ARMAND N. SPITZ, *Franklin Institute*

THE STORY IS TOLD that, after Christopher Columbus discovered Puerto Rico in 1493, he described the island to Queen Isabella by crushing his napkin in his hand and dropping it in a hundred wrinkles before her. The peaks and valleys of this tropical territory of the United States are earth features of unusual beauty. Not far from the southwest corner of the island is the Polytechnic Institute of Puerto Rico, surrounded by magnificent mountain scenery, overlooking a valley which stretches off toward the Caribbean Sea. The earth is rugged, its products are lush. Not infrequently there is a quiver of the ground to remind the local residents and the people of the world that only a very few miles away is one of the world's most active seismic regions.

The air above San German, the ancient town watched over by Polytechnic, is clear as only the air of a non-industrial region can be. The trade winds and the local circulations produce weather as nearly ideal as any that can be imagined, a year-round average temperature of 76°, with variations of no more than 20 degrees from season to season.

On this rich earth, breathing this friendly air, are those who turn their eyes to the sky. It is to such a group of students, in such a background, that a unique new educational opportunity will soon be offered. The Polytechnic Institute last month broke ground for its proposed Hall of Earth, Air, and Sky. In this building will be housed a miniature planetarium, a telescope, a seismological station, and a weather observatory, all to be operated by students under the direction of the faculty. It is planned to dedicate the building and instruments this spring, possibly at the May commencement.

The groundwork for so advanced a step in science education was well laid. The Polytechnic Institute of Puerto Rico was founded just 35 years ago to make available on the island an inter-racial, inter-denominational school, where the sons and daughters of rich landowners and peasant workers might meet on the same level for work and study. Today its campus covers 275 acres. There are about 60 buildings, most of them concrete structures designed to withstand earthquake, hurricane, and fire. The faculty is composed of both Puerto Rican and continental Americans, but the student body has been drawn almost wholly from the island itself. Beginning as an elementary school, the Institute soon met the demand for a high school, and later was formally changed to a liberal arts college. Authorized to confer higher degrees, the Institute graduated its first college class just 20 years ago. Its science courses already included physics, chemistry, and biology, but Dr. Jarvis Morris, then the Institute's president, hoped for expanded studies in science.

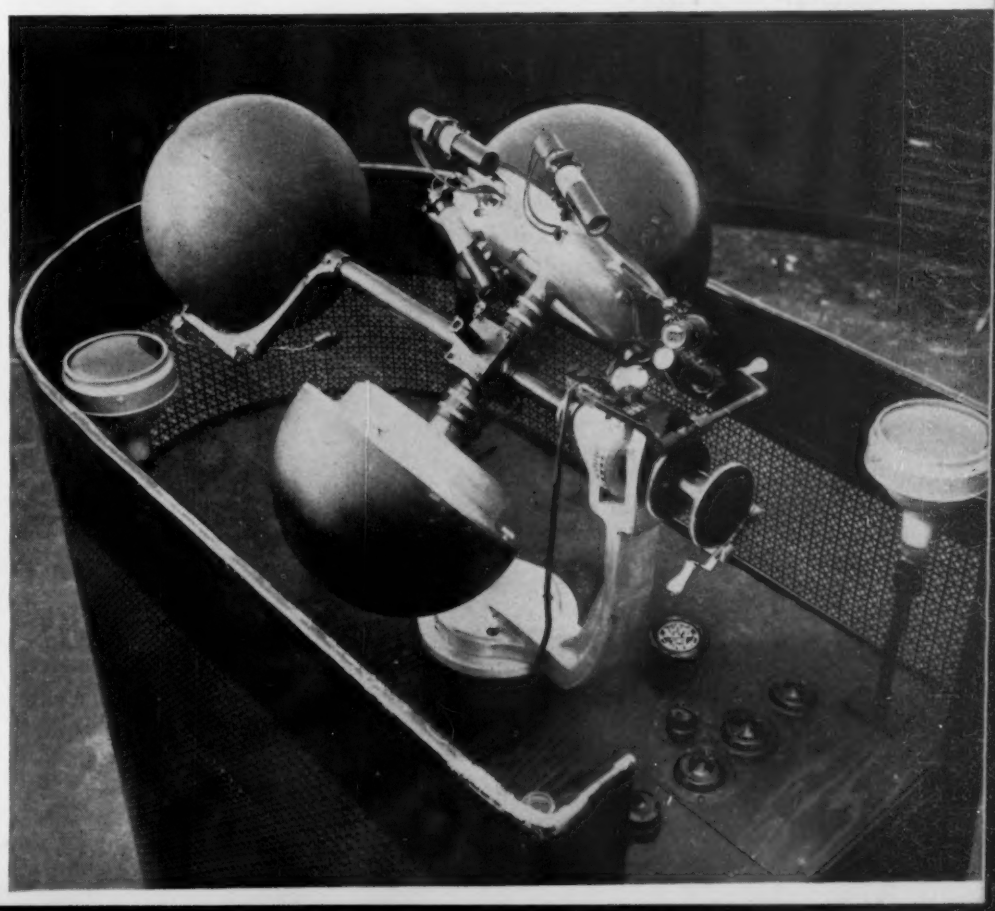
The idea for the Hall of Earth, Air, and Sky was born one day in May of 1945, when a lecturer, visiting the college to talk about new teaching techniques, casually mentioned his interest in astronomy. So many students were eager to know more that a stargazing session was scheduled for that evening, to be held on the roof of the guest house, Costello Hall. Although there was no time for a formal announcement, almost every student on the campus at the time made his way to the roof to peer through the hand telescopes and binoculars which had been hastily corralled. Some saw the Southern Cross for the first time, although they had lived their lives in a region where it could easily be viewed. There were the usual questions and many more that gave evidence that this was the door-opening for many — the full realization that a knowledge of the stars could be had.

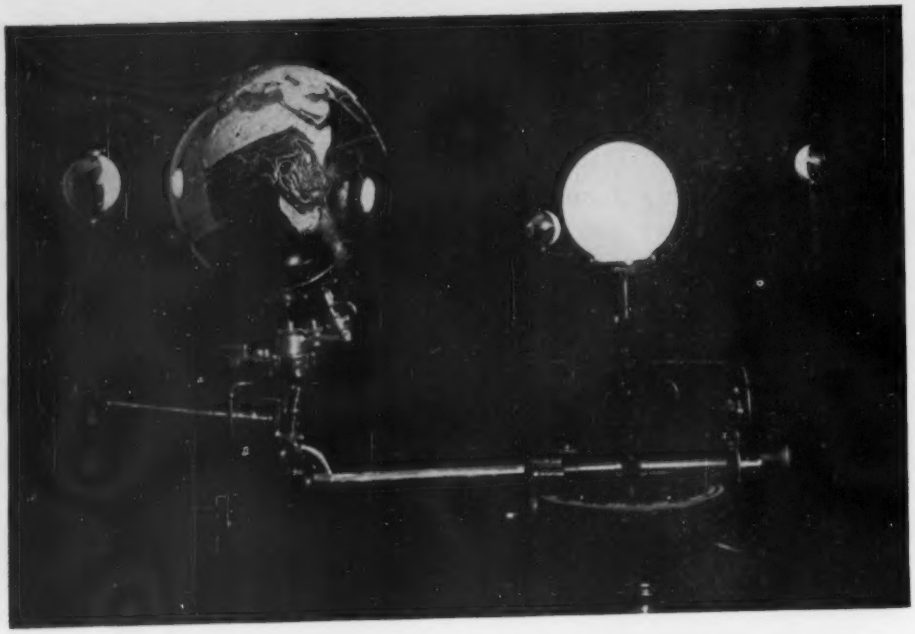
That night there was an earthquake. It was not a severe shock. It lasted for only a few seconds. Such a tremor is fairly frequent in Puerto Rico. The following day the avalanche of questions demonstrated to the visitor and to the college president alike that the field was fertile, if only something could be done about it.

A few days later this story was being told to Dr. Luis J. Fernandez, noted ophthalmologist of San Juan. He had just displayed his own portable refractor and his astronomical library. At his suggestion, a practically new 5-inch Zeiss refractor, with complete auxiliary equipment, was found.

Then Pedro A. Piza came into the picture. Senor Piza is a successful San

The Peerless planetarium star projector which is being installed in the 21-foot concrete dome at Polytechnic Institute. The hemispheres through which star images are projected are attached to the polar axis, controlled by the lower crank for daily motion. The upper crank turns the long axis in the plane of the equator to reproduce apparent latitude changes. Attached to the northern hemisphere are the sun, moon, and five naked-eye planet projectors. Four lights, two white and two blue, provide general illumination of the dome. The entire instrument is controlled by hand with switches and rheostats mounted on a panel before which the lecturer sits. Photo by Maycheck.





The Peerless planetarium orrery, shown here, is designed to demonstrate, as other orreries do, the fundamental motions of the solar system. This model, however, permits the observer to get the point of view of a person stationed on the earth, showing such phenomena as eclipses, phases, and the midnight sun.

Juan businessman, despite the fact that he is much more interested in his hobby of mathematics than he is in his business. Without formal training in mathematics or the sciences, he advanced himself to the point where he has written one book, *Fermagoric Triangles,* and a number of papers which have been published in mathematical journals in this country, in Europe, and South America. Being an amateur in mathematics he is inevitably interested in astronomy and other sciences. The thought that the interest of some young people of his island might be stimulated led him to agree to procure the Zeiss telescope for the Polytechnic Institute. Only a few months later, he volunteered to sponsor the move to give the college at San German the opportunity to teach with the use of such modern educational devices as the Peerless planetarium and orrery, weather instruments which will parallel the installations at many Weather Bureau stations, and a specially designed seismograph.

The Peerless star projector is a highly simplified instrument, designed to make it possible to recreate the appearance and motion of the heavens as seen at any time from any place. The dome at San German will be of concrete (see the front cover). Its internal diameter will be 21 feet, and the zenith will be 15½ feet high. A complete ventilating system will be built into the dome, so that there will be constant change of air even when the full capacity of about 60 persons is being accommodated. Under usual circumstances, class groups or other audiences will average about 40 persons.

The star projector is operated by hand, to demonstrate both daily and latitude motions. Individual projectors for sun, moon, and planets may be set for any desired date. It is possible to show the progress of an eclipse with a special device attached to the sun projector, while the moon projector can be simply adjusted to show the current phase. The Milky Way projector also supplies images of other diffuse objects such as the Andromeda galaxy, the Hercules and Perseus clusters, Praesepe, and the Magellanic Clouds. There are still other auxiliary projectors which can be used to demonstrate the seasonal motion of the visible constellations, and to indicate the meridian, ecliptic, equator, and hour circles. The Zeiss telescope will be housed on the roof, which will be used as an observing platform in connection with the program.

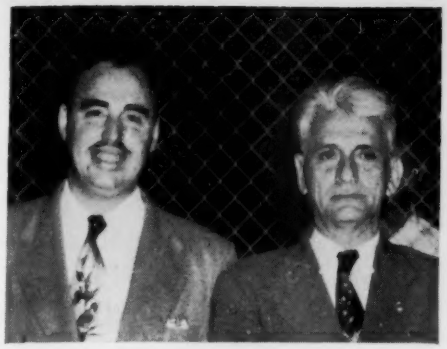
Pedro A. Piza, sponsor of the new installation at Polytechnic Institute.

In the lobby of Polytechnic's Hall of Earth, Air, and Sky, will be the Peerless orrery, a unique model of the mechanics of the earth-sun-moon system, together with attachments to show the appearance of such phenomena as retrograde motion of the planets, morning and evening stars, and various types of eclipses. The most unusual feature of this orrery is the ability to see the celestial line-up not only as viewed from the outside looking down but also as seen from various points on the surface of the earth. This device not only demonstrates the basic astronomical motions, but can also be employed in teaching meteorology and climatology.

The installation of weather instruments will include an electrical transmitting remote indicating wind vane and anemometer, with dials mounted in the lobby. Also on display and in operation will be a microbarograph, to make graph records of minute fluctuations of atmospheric pressure, a hygrothermograph to record changing temperature and humidity conditions, and a recording rain gauge which measures rainfall by translating the weight of accumulated precipitation in a bucket which rests upon a specially calibrated scale. The weather instruments will be inspected regularly by students delegated to make the official observations. In addition, the equipment will make an interesting action exhibit for all who come into the building, since the weather elements can be directly read at any moment. All weather instruments are standard Bendix-Friez equipment.

On the opposite side of the lobby will be the Polytechnic's earthquake observatory. A concrete pillar is being sunk to the rock of the mountain. Upon the pillar will be the specially designed Swift-Barnes electronic seismograph. The visible recording of this instrument makes it particularly suitable for teaching purposes, at the same time that it will be sensitive enough to produce seismograms of distant disturbances. Because of the fact that Puerto Rico lies so close to the Caribbean seismic center, the instruments have been built with extreme precision so that they can combine sensitivity with ruggedness. In addition, an alarm has been built into the detector unit, so that the first tremors of an incoming earthquake will send a signal to the nearby science building, where the Institute's administrative offices are located. This audible and visible signal will announce that something interesting is happening, and students and faculty alike can go immediately to the Hall of Earth, Air, and Sky, to watch the autograph of the island's tremors.

The spirit of teaching is independent of teaching equipment or techniques, but the process of learning can be greatly accelerated by using modern devices. No longer will the students in the hills of San German wonder with only a little less fear than their neighbors about the



Felix Juan Serralles (left) and Carlos Seijo, Puerto Rican amateur astronomers.

earthquakes which sometimes come. In the future, earthquakes will be a challenge to make their seismograph records useful to themselves in the learning process and to others who may be studying about the behavior of the earth nearby. Weather will no longer be the too easily ignored pleasant wind and temperature and humidity conditions; it will be the product of physical processes, regularly observed and interpreted, and a scientific method of analysis will supplant casual awareness.

With the dedication of the Hall of Earth, Air, and Sky, Polytechnic students and the people of Puerto Rico will also have the opportunity to study their man-made sky, not nearly so inspiring as the reality outside, but much more versatile from an educational point of view.

Puerto Rico is an island of strange contrasts and anachronisms. Giant transport planes are part of the same scene that is dominated by plodding oxen, who might seem to have been brought from Biblical lands and times. Hundreds of thousands of jibaros or peasants, who barely manage to scrape together enough to buy their rice and beans, sometimes turn their eyes upward in the age-old awe and wonderment which comes with an awareness of the stars. In a land struggling to lift its masses to literacy, there has grown up the Polytechnic Institute, with courses planned to give the earnest students of the island a view not only of the knowledge man has gained through the centuries, but also an understanding of the obligation that such knowledge places upon them.

Names of Meteor Correspondents:

Rolande Alcala Caquias, Playa de Ponce; Miguel de los Angeles Correa, Guayanilla; Victor Medina Cruz, Fajardo; Placido Feliu, San German; Amoros Mendez, Bayamon; William H. Montalvo, San Juan; Frances Pinero Mundo, Rio Piedras; Sergio Rubi Negron, Rio Piedras; Carmen Adele Pico, Santura; Mario Quiles, Guanica; Elfren Romales, Caguas; Angel M. Rosario, Hato Rey; Francisco Rosario, Morovis; Carlos Seijo, San Juan; Vicente Urbistondo, Perez.

Meteor Train over Puerto Rico

ON JANUARY 12th, a Sunday, just after sunset over the island of Puerto Rico, a brilliant fireball illuminated the sky and left in its wake a train which lasted probably half an hour and was visible from all parts of the island. Thousands of persons were startled by the sudden flash of light and speculation ran high as to the cause of this unusual phenomenon.

Carlos E. Seijo, of San Juan, well-known amateur astronomer, sent *Sky and Telescope* a clipping from *El Imparcial,* daily illustrated newspaper, which described the meteor briefly and carried a photograph of the meteor train. This picture is reproduced here, as it represents a very fine case of an enduring train, and illustrates the changes which take place in such trains if they remain visible long enough for the effects of upper atmosphere air movements to be noticeable. As the sun had just gone down, the meteor train was in the sunlit portion of the atmosphere, which accounts in part for its prolonged visibility.

In response to further communication with Mr. Seijo, and an item in *El Imparcial,* we have received letters from 15 independent observers of the phenomenon; the names of these correspondents are given below. Further information is still required, particularly as to the beginning and end points of the meteor,

Gilberto Vazquez, "El Imparcial" photographer of the meteor train picture.

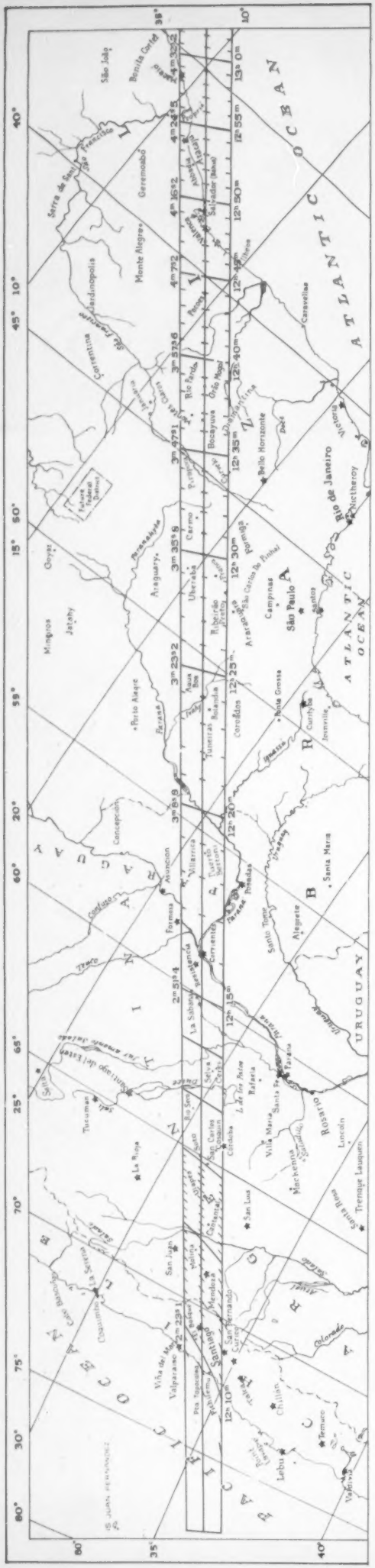
This picture of the train of the meteor was taken some 10 or 20 minutes after the actual flight of the fireball. Photograph courtesy "El Imparcial."

for the accounts on hand at this time do not include sufficient data of this kind.

There is considerable variation in the reported time of the occurrence of the meteor, estimates ranging all the way from 6:10 p.m. (Atlantic standard time) to 6:35, but apparently 6:20, which was 10 or 15 minutes after sunset, is a good average. Mr. Seijo reports that it was about 20 minutes before any distortion in the straight-line extent of the train could be noticed, but other observers state that changes began in five or 10 minutes. Just how long after this the picture was taken by *El Imparcial's* photographer, Gilberto Vazquez, is not known at present. The changes observed in meteor trains of this kind may be of value in studying motions in the upper atmosphere.

Several observers reported hearing detonations right after the meteor's passage. Apparently the fireball was not seen to explode, but one observer thought it as big as a basketball. The flight was generally in a southwesterly direction, from almost over San Juan on the north shore of the island to Guanica on the south shore. Mr. Seijo's observations and those of Felix Juan Serralles, at Ponce, also on the south shore, agree in this general trajectory. Thus the meteor passed nearly overhead for two of the largest cities on the island. However, William H. Montalvo, San Juan, in a report to the American Meteor Society, states that the beginning point was halfway up the sky from the south point to the zenith, and that the end point was in the direction of the setting sun.

The meteor itself was described by most observers as red or orange-red. All observers agree on white as the color of the illuminated train, although some said it later changed to rose, which may have been the effect of the deepening sunset.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São Paulo
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Belo Horizonte
Victoria
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Bocayuva
Rio Pardo
Carmo
Campinas
Ribeirão Preto
Araraquara
São Carlos do Pinhal
Araguary
Uberaba
Jatahy
Mineiros
Goyaz
Rio Verde
Jaraguá
Anhanguera
Rio Claro
Tieté
Tamandoá
Tupy
Tupan
Tres Barras
Jaguary
Rio Grande
Pelotas
Porto Alegre
Parana
Uruguay
Concepcion
Corrientes
Formosa
Resistencia
Villarrica
Asuncion
Paraguay
Tucuman
Santiago
Rosario
Santa Fé
Paraná
Buenos Aires
Bahia Blanca
Mendoza
San Juan
La Rioja
Cordoba
San Luis
Chillan
Temuco
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Valparaiso
Viña del Mar
Los Andes
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Villarrica
Asuncion
Concepcion
Tucuman
Santiago
La Rioja
Cordoba
San Luis
San Juan
Mendoza
Chillan
Temuco
Lebu
Valdivia

NEWS NOTES

By Dorrit Hoffleit

OUR SYSTEM AND ANDROMEDA

The center of our Milky Way system is hidden behind clouds of obscuring dust and gas. A nuclear bulge discovered by W. Baade at Mount Wilson "represents a significant advance in the study of galactic structure," according to Dr. Ira Bowen's report of the work accomplished at the Mount Wilson Observatory for the year 1945-46. Photographs secured with the 100-inch telescope with red-sensitive plates show extremely high star densities in Sagittarius, suggesting that the region studied is a part of the galactic nucleus. This region, five degrees from the presumed center, shows more than 400 variable stars per square degree, surpassing by a factor of at least 30 the numbers in Milky Way fields previously studied. The majority of these variables turn out to be the cluster-type Cepheids usually found in comparatively small numbers at low galactic latitudes. Moreover, they are all at approximately the same distance from us. Most of them have maximum magnitudes between 16.5 and 18.0, and their numbers fall off rapidly with fainter magnitudes.

Since cluster-type variables all have nearly the same absolute luminosity, their distances can be computed if proper allowance is made for interstellar absorption. Provisionally, the distance of this group of variables is found to be nine kiloparsecs. It is probable that it is a part of the "nuclear bulge," and as such indicates that the central region of our system is composed of stars (Baade's type II) like those in the central region of the Andromeda galaxy.

As for progress on the Andromeda nebula itself, Dr. Baade has redetermined its diameter from studies of *B* stars and open clusters. The new value is about 20 kiloparsecs (65,000 light-years), which compares well with the diameter of our own system ascertained from studies of the same classes of objects.

REFRACTION IN ARCTIC REGIONS

Everyone has seen a flattened, oval-looking sun near the horizon. Students of astronomy appreciate the fact that differential atmospheric refraction is responsible for this effect. In arctic regions, where the sun never gets very far above the horizon, such refraction may seriously handicap celestial navigation by explorers and aviators. There are several mathematical theories for telling the true from the observed apparent positions of celestial objects. All the theories give results in good agreement except when the celestial body under observation is close to the horizon, as the sun is for arctic explorers.

Professor Charles H. Smiley, of Brown University, is collecting data on the change of the apparent vertical diameter of the sun caused by the change of the angle of refraction for all latitudes. While on his solar eclipse expedition to Brazil he will obtain the data for all latitudes between Providence and Rio de Janeiro. Through the co-operation of the U. S. Navy Bureau of Research, the Finn Ronne antarctic expedition will carry out the observations from $-22°$ to the South Pole. Within a year it is hoped that the observing program will be extended to the North Pole also. All the data will be reduced under the direction of Professor Smiley for the preparation of complete new tables of solar refraction. These tables may then help scientists to choose between the various refraction theories.

AMERICAN METEORITE MUSEUM

At Winslow, Ariz., near the great Meteor Crater, a new museum has been opened, founded by Dr. and Mrs. H. H. Nininger, expert meteoriticists. Containing one of the world's largest meteorite collections, the museum boasts the world's only known copper meteorite, meteorites showing diamonds, and one that actually fell into a house.

WEATHER CONTROL PREDICTED

Speaking before the Institute of Aeronautical Sciences recently, Dr. V. K. Zworykin, of Radio Corporation of America, ventured to predict that the time is approaching when man will be able to do something about the weather. New electronic calculators will play an important role. Of course they will not be able to divert an oncoming storm; but because of their speed in making the computations necessary for forecasts, they will yield results quickly enough to give the future weather man time to intercede with the weather.

Man-induced changes over large areas or changes sufficient to bring about climatic differences are not anticipated. Purely local modifications are, however, possible, according to Dr. Zworykin. Wartime developments demonstrated, for example, the possibility of producing or dispelling fogs, and of producing snow artificially. "The hope for effective weather control rests in the fact that the condition preceding many of the weather processes which it may be desirable to control is essentially unstable or metastable. . . . Thus, while the energy finally released may be enormous, that required to trigger the release may be quite modest. Furthermore, the magnitude of the triggering energy required will greatly depend on the time and place at which it is applied."

Two methods are available to provide energy for altering the weather. One consists of spreading a combustible substance over a large area (for instance, oil on water) and igniting it. The resulting updraft should change the motions of the higher-level air masses. The other method would utilize solar radiation at "weather control areas" — large absorbing areas blackened by carbon deposits, which could at will be changed into highly reflecting areas by the formation of artificial fogs.

ASTRONOMY IN THE ANTARCTIC

Professor Robert L. Nichols, head of Tufts College department of geology, left in January to take part in the antarctic expedition headed by Comdr. Finn Ronne, USNR. Newspaper accounts report that the expedition will explore the antarctic for uranium and other mineral deposits, employing the 1,000-foot ship, *City of Beaumont*. Dr. Nichols took with him a set of *Sky and Telescope*, for reference in observing the southern skies.

The expedition is being sponsored by the federal government and private groups, including the American Geological Society and the American Antarctic Association. It is expected that in a year and a half vast areas "down under" will be thoroughly charted and explored. Studies in oceanography, cosmic rays, aurora australis, meteors, botany, and zoology, are to be carried on. In addition to his duties as a geologist, Dr. Nichols will carry out most of the work related to astronomy.

EDUCATOR DIES

William B. Stearns, of Milton Academy, Milton, Mass., although a member of several astronomical societies, was probably not too well known to astronomers outside the Boston area. We wish to commemorate him in these notes because of his achievements in introducing navigation and astronomy into a secondary school curriculum. After having given successful courses in navigation at Milton Academy, he founded an observatory there, which later rendered service to Harvard and the American Association of Variable Star Observers. Dr. Stearns died in Boston in January at the age of 76. Astronomy is a field well adapted for study in secondary schools — may his fruitful experience be repeated in many other such institutions.

American Astronomers Report

Here are highlights of some papers presented at the 76th meeting of the American Astronomical Society. Complete abstracts will be published elsewhere.

Earth's Gaseous Envelope and the Sun

METEOROLOGISTS, astronomers, and ionosphere experts together presented a symposium on current problems of the relation of solar variations to changes in the earth's atmosphere. The gaseous envelope in which we live is not only the medium where weather is made, but that in which we carry on a significant amount of modern communication and high-speed travel.

Dr. Donald H. Menzel, of Harvard Observatory, who arranged the symposium, reviewed the various earth-sun relationships. He pointed out that solar-caused variations in the earth's magnetism, aurora and night-sky luminescence, and ionospheric changes were established without question. Variability of the ozone layer, itself produced by the sun's ultraviolet radiation, is highly probable but subject to further test. High-frequency radio noise (on radar and television frequencies) comes to us from active solar regions. The problem of weather changes produced by the solar variations is highly important, but many of the suggested relationships are still unproved. As for the effects on life and human affairs, proposed by many writers in the past, nothing definite has yet been established. As early as 1801, Sir William Herschel examined the relation between solar activity and the price of wheat, and discussed possible weather effects. But almost all natural phenomena show cyclic behavior, so the mere existence of similar cycles cannot be considered conclusive proof in any one case.

The Harvard astrophysicist pointed out that definite physical connections must be established before any correlation can be accepted. For these, we must understand the physical processes, both in the sun and in the earth's atmosphere, which produce the observed effects. Sunspots have in the past been used because of the ease with which their variations are observed, but other changes, such as in prominences, faculae, flocculi, granulation, and in the solar corona, may provide better indexes.

As an example of the kind of physical analysis required to develop these studies, Dr. Menzel proposed a mechanism to account for the recently discovered radio emission from the sun. The greatest portion of the energy detected by radar turned to the sun comes from active spot regions rather than from the entire surface. The intensity of the emissions, in the range from 30 to 200 megacycles, may exceed the expected black-body emission from a sphere at 6,000° C. by a factor of 10,000. This is all the more surprising when it is realized that the sun's envelope is a kind of ionosphere which tends to retain within the sun all such long-wave radiation.

If we regard the sun as a sphere, there is no chance of accounting for the excess emission, Dr. Menzel believes. But the long, threadlike prominence filaments that surge into coronal regions may act as radiation surfaces for these radio waves many thousands of times greater in total area than the spherical solar surface. Just as a lamp with a long filament radiates more energy than one with a short filament, these prominence threads emit far more radio energy than the solar surface does. Thus the sun sends up its own radio antennae. There should be a direct relationship between solar radio outbursts and the bright hydrogen eruptions viewed against the solar disk.

Atmospheres in Action

MOTION PICTURES of events in the sun's atmosphere have been a reality since the pioneer work at the McMath-Hulbert Observatory in the early '30's. Prominence activity on the sun furnishes spectacular material to illustrate the variety and power of the forces at work on our nearest star. These pictures may be taken with a coronagraph or the spectroheliokinematograph. Dr. W. O. Roberts, of Harvard's Climax station, showed the latest films taken at the High Altitude Observatory, including the sequence of the eruptive arch prominence of June 4th last year, the greatest ever recorded and almost as large as the sun itself (see *Sky and Telescope,* No. 58, August, 1946). Another sequence showed eruptions whose form resembled the atomic bomb, complete to the mushroom cap, except on a tremendously larger scale.

Dr. Roberts pointed out that the decisive stages of World War II were fought during a minimum of solar activity (sunspot minimum was about 1944.3 from Mount Wilson data), and this accounted for a good part of the excellent reliability achieved by the radio communication upon which much of our military strategy depended. The quietness of the sun and its atmosphere resulted in relatively few radio disturbances. At present, with the maximum of solar activity approaching, radio service interruptions are more frequent and intense.

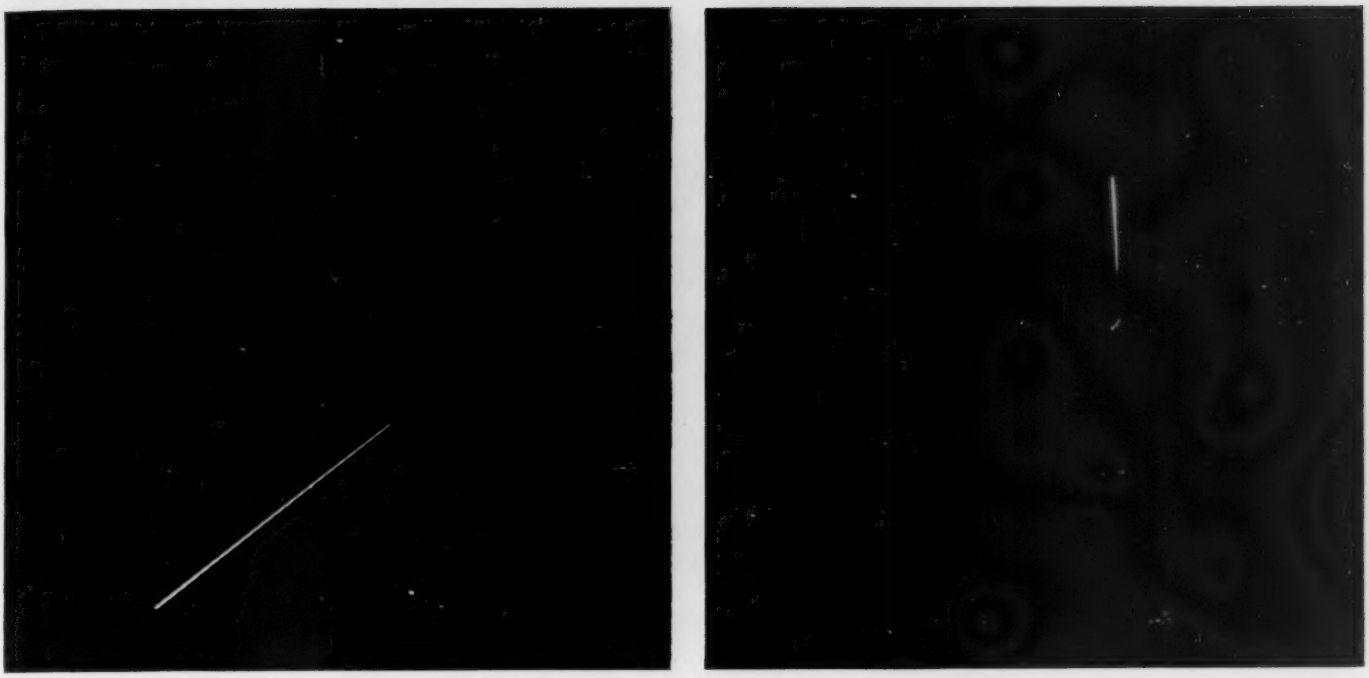
Sunspots, corona, and prominences all appear to be essentially in the same phase of their solar activity cycles at the time of minimum, Dr. Roberts stated.

With Alan H. Shapley, formerly of the Department of Terrestrial Magnetism of the Carnegie Institution and one of the symposium speakers, the Climax staff has jointly developed a new correlation between the appearance of brilliant areas of coronal emission at the east limb of the sun and the occurrence of magnetic disturbances very strongly three to seven days later. The terrestrial effects of the coronal conditions are felt while the areas of bright emission are still in the half of the sun's disk that has not reached the solar central meridian.

In his symposium paper, Mr. Shapley pointed out that present evidence indicates that a seat of effective solar activity is localized on the sun and rotates with the sun. Thus, instead of using relative sunspot numbers or other generalized indexes for correlation and prediction purposes, the activity and coordinates of each separate active region on the visible disk of the sun should be employed.

As for the ionosphere itself, radio techniques have advanced to the stage that continuous records may now be made of changes in the characteristics of the various layers of the ionosphere. These are the layers which selectively reflect and refract radio energy, and it is by their existence that we are able to transmit radio messages around the curved surface of the earth. By continuously propagating and receiving the reflected radiation of certain wave lengths, it is possible to keep track of each ionosphere layer, and particularly to know how it changes its height with time. Mr. Shapley showed motion pictures, made by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, of such ionospheric records. (The pictures are lapse-time and speed up the events in the same way that solar prominence pictures are accelerated.) Storms in the ionosphere are shown that sometimes blast the layers right out of existence. The motion picture screen represents the co-ordinates of wave length and height.

Data on these ionosphere changes were presented by Dr. Joseph H. Dellinger, chief of the Central Radio Propagation Laboratory of the National



PHOTOGRAPHS OF THE FIRST V-2 NIGHT FLIGHT, DECEMBER 17, 1946

These two pictures show the path of the first night flight of a V-2 rocket in the experimental firings at White Sands Proving Ground in New Mexico. They were taken with special meteor cameras of three inches aperture, f/2.5, equipped with shutters rotating at 1,800 r.p.m. and operated under the direction of Fred L. Whipple, of Harvard Observatory, with the assistance of Joseph L. Gossner, student in astronomy at Harvard. The cameras were designed to photograph the artificial meteors to be launched from this rocket, at heights of about 30, 40, and 50 miles, but the firing mechanism failed to work and no "meteors" were observed visually or photographically.

Nevertheless, these pictures, taken (left) from a station five miles west and four miles north of the launcher, and (right) from three miles south of the launcher, demonstrate well the problems of duplicate meteor photography. The exposures were started 50 seconds after the rocket was launched and were continued for one minute. The bright part of each trail is the jet of the V-2. About 22 seconds after the start of the exposure, burnout occurred, but the hot carbon vanes in the jet stream were still visible, producing the faint parts of the trails. The rocket was 27 miles high at the time of burnout. It reached a velocity of 5,450 feet per second and achieved a maximum height of 114 miles. It landed 24 miles north and a little west of the launcher, so the early trajectory was bent a few degrees to the north of the vertical.

The photographs are here oriented with north at the top. Notice the change in appearance of the trails from the two stations, and the difference in direction with regard to the background stars, caused by the different angles from which the flight was viewed. The measurement of such trails for meteors leads not only to the calculation of the orbits of these particles, but also to information concerning the temperature and density of the upper atmosphere.

Bureau of Standards, and also by Dr. Harlan T. Stetson, whose Cosmic Terrestrial Research Laboratory at Needham, Mass., has for many years carried out a program to correlate radio reception, solar activity, geomagnetic changes, and the aurora. Marked annual variations are found in the ionization of the E and F layers, with a maximum for the E layer in midsummer and for the F layer in midwinter in the Northern Hemisphere. Sky-wave (reflected) propagation at high frequencies cannot be satisfactorily predicted from ionization at the reflecting layer alone.

Temperatures of Atmospheres

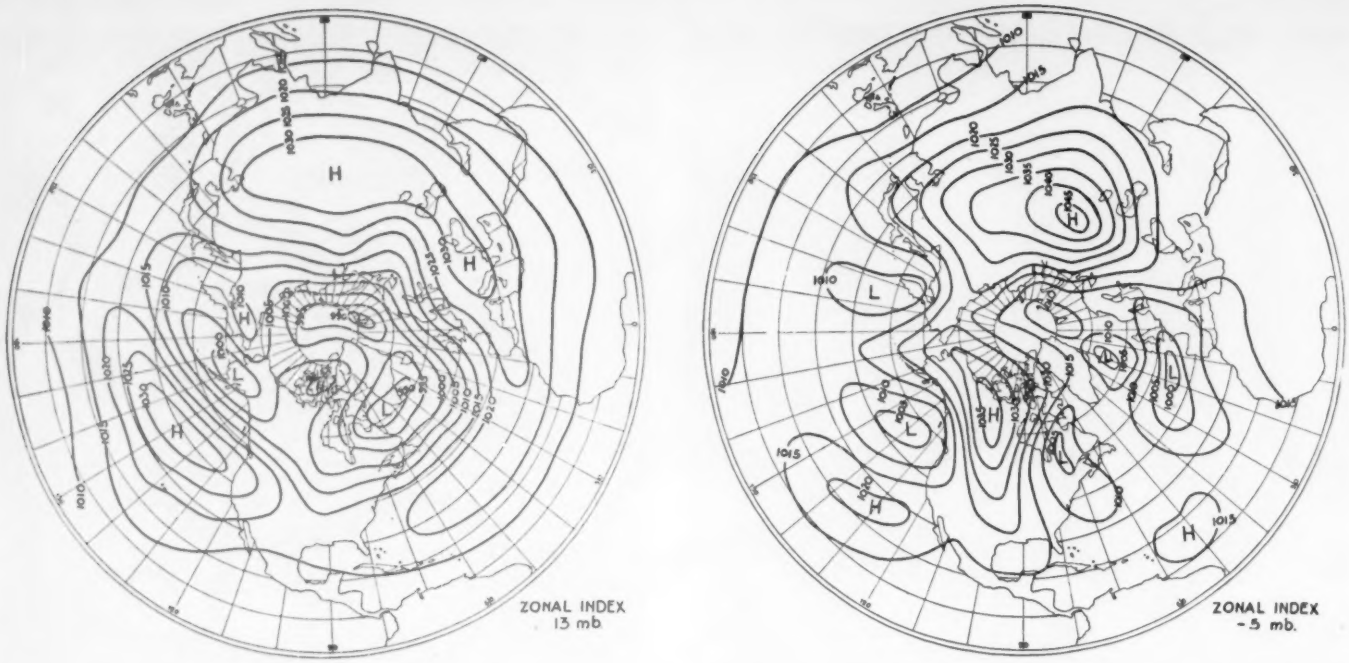
DR. LEO GOLDBERG, of the University of Michigan Observatory, reporting on a joint research by himself and Dr. Menzel, described two possible theories to explain the anomaly of the solar corona, which appears to have a temperature of 700,000° C. or higher, more than 100 times hotter than the surface of the sun itself. The spectrum of the corona is consistent with the idea of excitation produced by a number of tiny hot spots on the solar surface, their combined area less than one square kilometer. Limitations of resolving power would prevent such tiny areas from appearing excessively bright in visual light.

The alternative and possibly favored explanation is that streamers or pockets of gas bubble up from the interior of the sun. This material, perhaps as hot as a million degrees, gradually cools and produces various forms of coronal and prominence streamers. Either hypothesis requires a large amount of radiation from the sun in the extreme ultraviolet region of the spectrum, and this would have a significant effect on the earth's atmosphere.

While the earth's atmosphere does not compare in its temperature range with that found on the sun, it is well known that at about 40 miles above the surface the earth's air is near the temperature of boiling water. Dr. Fred L. Whipple, of Harvard, presented a critical summary of the determinations of temperatures and densities in the atmosphere to a height of about 125 kilometers. He pointed out how well recent V-2 rocket flights have confirmed the characteristics of the tentative standard atmosphere of the National Advisory Committee on Aeronautics, a confirmation also provided by two-camera observations of meteors. In future work, he said, there should be close liaison between meteor studies in the photographic and in the radio regions of the spectrum.

Lower Atmosphere Problems

TWO PAPERS by Massachusetts Institute of Technology meteorologists, Dr. H. C. Willett and Dr. B. Haurwitz, indicated their primary concern with the lower atmosphere, where our weather takes place, at least in its final stages having immediate effect on surface life. But in each case, these



These charts show the distribution of mean pressures in the Northern Hemisphere for similar periods a year apart, at left for November 12-16, 1938; at right for November 14-20, 1937. The zonal index is the difference between the pressure at latitude 35° (usually high) and the pressure at latitude 55° (usually low). In the 1937 case the zonal index is negative, tending to upset the usual pattern of prevailing westerly winds in the 35°-55° zone. This results in a weak circulation which is broken into more and smaller centers. Other noticeable differences in the 1937 pattern are the splitting of both the Aleutian and Icelandic lows into two parts, and the presence of a high-pressure area over Canada. In the case of high index (1938), the low-pressure systems are concentrated toward the pole, with the highs to the south, a condition favoring strong circulation of the atmosphere. The interval of the pressure contours is five millibars. Diagrams courtesy Massachusetts Institute of Technology.

scientists indicated the need for finding a mechanism whereby weather changes in the troposphere occur as a result of changes in the temperature and pressure distribution in the upper atmosphere.

The ozone layer, extending from 20 to 40 kilometers above the earth's surface, and produced by the action of ultraviolet sunlight, may hold the key to the problem. Dr. Haurwitz proposed that sudden bursts of solar energy, particularly in the ultraviolet, might raise the temperature of local regions of the ozone layer as much as 50° absolute. As regions where the sun was near or below the horizon would not be affected, horizontal temperature and pressure gradients would be produced and the ozone layer set in motion. The resulting mass transport in the ozone layer must then be reflected in pressure changes at the ground, inasmuch as the mass of the ozone layer is appreciable. Higher-level changes, such as in the ionosphere, would be of negligible effect, and the ozone layer would represent the link between changes on the sun and the weather on the earth's surface.

Weather departures from normal, sometimes lasting almost continuously for a month, a season, a year, or even a period of years, may be directly traceable to solar activity, but Dr. Willett pointed out that the necessary erratic fluctuations of sources of heat and cold are not observed in the troposphere and must be looked for in the upper atmosphere. But the mechanism is yet to be found and understood, so that today meteorologists are able to explain and predict only the usual short-period, day-to-day fluctuations which are observed in the movements of air masses, frontal systems, and the usual sequence of migratory highs and lows. The occasional large-scale erratic fluctuations, which in the course of a few days radically alter the general circulation pattern over a large part of the Northern (and possibly also the Southern) Hemisphere, and similar long-period fluctuations in the general circulation, have no adequate explanation. More information on solar heating of the upper atmosphere may help solve these problems.

Eclipsing Binaries

DOUBLE STARS that occult each other came in for a large share of attention, first in a symposium on eclipsing binaries, at which Dr. Henry Norris Russell, of Princeton University, presided, and then in the lecture, "The Royal Road of Eclipses," in which he summarized the present progress in the study of these important stars. At the symposium, theoretical papers were given by Dr. S. Chandrasekhar, of Yerkes Observatory, on problems of stellar limb darkening, and Dr. Zdenek Kopal, Harvard College Observatory, on some unsolved problems in the theory of eclipsing variables.

The Yerkes astronomer described recent progress of investigations aiming to establish the center-to-limb variation of stellar surface brightness on a theoretical basis. He also discussed the problem of the transfer of light emitted by one component of a close binary and intercepted by its mate, the light then being absorbed (or scattered) and re-emitted in the atmosphere of the second star.

Dr. Kopal pointed out that at present we know very little of what the light and radial-velocity curves should be for double stars in which the components are nearly or actually in contact. Consequently, we cannot determine whether or not the observed characteristics of any known eclipsing system indicate that its components are in actual bodily contact. Another problem is the asymmetry of the light curves of many eclipsing systems, these cases being too numerous to be regarded as exceptional. Dr. Kopal conjectures that such stars may undergo non-radial pulsations or oscillations, similar in nature but not the same as the radial pulsations of Cepheid variables.

Dr. R. M. Petrie, of the Dominion Astrophysical Observatory, described a method for determining the relative luminosities of close binary systems by careful photometry of line profiles in their spectra. The method has already been applied to some 60 spectroscopic binaries, including 16 eclipsing systems. The results show that the spectroscopic binaries obey a mass-luminosity relation.

Spectroscopic studies of eclipsing systems were also reported by Dr. Otto Struve, of Yerkes and McDonald observatories, who presented a summary of three years of work on this subject. The ultimate purpose of the program is to determine the physical characteristics of close double stars and, if possible, to throw new light upon the old problem of their origin and evolution.

The spectra of nearly 100 systems were analyzed, providing in general information of three distinct kinds: 1. The velocities of the components in the line of sight are inferred from the Doppler displacements of the absorption lines. 2. The speed of axial rotation of one or both components is determined from the contours of the lines (see *Sky and Telescope,* No. 61, November, 1946). 3. The amount of absorbing gas in a column of unit cross section, in front of one or both components, can be derived from the intensities of the absorption lines. In addition, the velocities are used to derive the mass ratios and masses of the binary components; the rotations give us information concerning their sizes; and variations in the line intensities indicate currents of gas within a system which move about in complicated orbits and are not directly attached to either component.

Contrary to previous views, Dr. Struve has found that eclipsing systems have components which may differ in mass by factors of five, 10, 20, or even more. Astronomers are yet uncertain as to whether or not there is any real break between the mass ratios of double stars and those of planetary systems, where the factor is about 1,000 (Sun-Jupiter ratio is 1,047). The masses of the heavier components are approximately normal for their spectral characteristics, but their sizes, in the closest pairs, are abnormally small — about one half the size of an average star of similar temperature. The less massive components are abnormally large and are sometimes of unexpected mass, size, and brightness.

The rotation around the axis of each component usually proceeds in exact synchronism with the orbital revolution, but in a few systems of relatively short periods of revolution the rotational period of the small, heavy component is several times shorter than the orbital period. Only in one system is the period of rotation longer than the period of revolution. In all systems, however, the direction of rotation is in the same sense as the orbital revolution.

Eclipsing Stars in Space

TWO PAPERS by Harvard astronomers concerned the distribution of eclipsing stars in space. In a current survey of the brighter eclipsing systems, Dr. Cecilia Payne-Gaposchkin has found an unusually large number of these stars in the Carina-Vela region of the Milky Way, between galactic longitudes 240° and 270°. This concentration is probably apparent rather than real. It is found to coincide with a genuine concentration of other objects, especially classical Cepheids, Wolf-Rayet stars, and bright *B* stars, which extends from the Cygnus region, running between the sun and the galactic center, through the Carina-Vela region. The Carina direction is further characterized by relative poverty in red stars.

A contrast to this arrangement is presented by the Sagittarius-Scorpius-Ophiuchus region, which is notable for its richness in cluster-type variables, long-period variables, and novae, none of which share the Carina concentration. The difference in makeup of these two groups of stars suggests that they may furnish a basis for the study of two distinct types of stellar population.

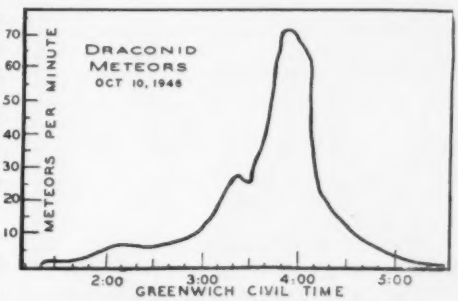
Among the many types of eclipsing binaries, those named after W Ursae Majoris have been found to be at least 25 times as numerous per volume of space as all other kinds combined. This observation, Dr. Harlow Shapley pointed out, bears significantly on the problem of the origin of double stars, and suggests that there may be a genetic difference between the W Ursae Majoris pairs and the more commonly studied eclipsing pairs of unequal components and great spectral variety. W Ursae Majoris stars are characterized by short periods (ranging from 0.22 to 1.33 days), and the equality of their components in size and brightness. Their masses and temperatures are very nearly the same as those of the sun — they are solar-type stars — and their components may often be so close together that tidal forces pull them into superficial contact.

In the Harvard survey conducted under the direction of Dr. Shapley, 4,000 plates in 18 fields have been available for study. The plates were made mostly with the 10-inch Metcalf camera at Bloemfontein, South Africa, the field of each covering approximately 60 square degrees. The surveys are essentially complete to the 15th magnitude, but many uncertainties beset the research. Large ranges in light variation are naturally found most easily; spottedness in space absorption affects magnitude determinations; and misidentification may occur when spectrum or color is not known for a short-period variable, as cluster-type Cepheids resemble W Ursae Majoris stars except in color. Nevertheless, the results of the study can be summarized as follows: 1. In nine fields with galactic latitudes equal to or greater than 40°, the solar-type binaries are 78 times as numerous per unit volume of space as typical eclipsing systems. 2. For five fields in intermediate latitudes the ratio is 69. 3. For four fields in the direction of the galactic nucleus, the ratio is 15. In high latitudes and at great distances, the predominance of the W Ursae Majoris stars is even more pronounced, indicating the high concentration of typical eclipsing binaries to the galactic plane.

In making his analysis, Dr. Shapley assumed the mean absolute photographic magnitude of the typical Algol-type variables to be +1.0, and that of the W Ursae Majoris stars to be +4.5.

Draconid Meteor Maximum

WHILE THE DISTANCE of the earth from the orbit of Comet Giacobini-Zinner was changing by only about two per cent, the number of Draconid meteors seen on the night of October 9-10, 1946, was changing by several hundred per cent, according to data compiled by Dr. C. C. Wylie, of Iowa State University. As the accompanying chart shows, the meteors were more numerous before maximum than afterward, presumably because the earth was then closer to the orbit. This suggests that the swarm of meteoric particles is spread out in the plane of the comet's orbit, and that the time of maximum of such a shower should be predicted by calculating the time when the earth is to pass through the plane of the orbit.



This graph by C. C. Wylie shows how the meteors associated with Comet Giacobini-Zinner increased and decreased during the shower on October 9-10, last year. The sharp maximum indicates that the meteoric particles are spread in a relatively thin sheet in the plane of the comet's orbit.

The Iowa astronomer employed meteor counts from six observing individuals or groups, located at Central College in Missouri, at Griffith Observatory, Los Angeles, Cal., and at the universities of Oklahoma, Oregon, South Dakota, and Wisconsin. Five of these groups agreed in placing the maximum at between 3:51 and 3:52 GCT, October 10th. The counting units were, respectively, nine, one, one, one, four, and five persons, and the average numbers of meteors per minute for a single observer at maximum were 50, 63, 47, 73, 74, and 61. Dr. Wylie

pointed out that the counts were higher in the West and North, individual counts in Oregon being as high as the highest group counts in the Middle West. This probably was due partly to clearer skies, and partly to the fact that the radiant was higher in the sky for the Oregon observer.

As no known comet can itself strike the earth, the elements of a comet's orbit must be modified in order to predict the radiant for associated meteors which are to strike the atmosphere. Dr. Wylie used three possible modifications of the Giacobini-Zinner elements. First, as the earth was a small distance inside the comet's orbit, he reduced the size of the orbit (semimajor axis), holding the other elements unchanged. The resulting radiant missed the observed radiant by 0.3 degrees, or a little more than half the apparent diameter of the moon. By the second method, in which the eccentricity was changed, a similarly displaced radiant was calculated, but the third method, in which the angle of perihelion was changed, missed the observed radiant by 1½ degrees. Dr. Wylie found the first method most satisfactory. He pointed out, however, that when final results from photographs taken by various astronomers to determine the Draconid shower radiant are available, the position of the radiant he used in his calculations would be subject to some modification.

Institute of Navigation

On Friday and Saturday, April 18th and 19th, the Institute of Navigation will hold a two-day Eastern Regional meeting at Boston, Mass. All persons interested may obtain further information from Capt. John S. Barleon, USN Ret., 27 Coolidge Hill Road, Cambridge 38, Mass.

AAVSO to Meet in May

The spring meeting of the American Association of Variable Star Observers will be held at Hood College, Frederick, Md., on May 16th and 17th, at the invitation of Professor Leah B. Allen.

LETTERS

Sir:

The inversion of craters which has been noticed on the lunar photographs on the covers of **Sky and Telescope** may be observed visually on the moon.

I had the moon under observation recently through a 4-inch Clark refractor when the terminator was about 5° longitude W. The craters bordering the southern quadrants were in the field of view. While I was away from the telescope a few moments the field drifted and when I returned the craters were at the edge of the field, and presented the striking inversion phenomenon. I held them in this position and took several fresh looks and each time the inversion illusion appeared. When the craters were moved to the center of the field the phenomenon could not be obtained. This effect is caused, I believe, by a slight degree of spherical aberration in the lens.

This conclusion is supported by observations on small disks of color painted in fields of contrasting colors. When viewed through the uncorrected lens of an ordinary magnifying glass the adjacent contrasting color areas appear at different levels with respect to each other. This effect is only slightly or not at all apparent when the magnifying glass is not used.

JOHN J. O'NEILL
Freeport, N. Y.

Sir:

The following experiment would give the basic reason for the inversion effect. If a mound of sand made in the form of a footprint were photographed at 8 a. m. (with normal shadows), everyone looking at the photo would insist that it was a depression. But, going further, tell them which side is east or west and ask them what time the photo was taken and the answer would be, "Sometime in the afternoon." What they have actually done is put the sun in the wrong place in relation to the subject, which is unconsciously assumed to be always a depression. It is apparent then that the mind, not the eye, placed the illumination in relation to the subject.

Thus, to effect a reversal at any time it must first be necessary to fix in one's mind the direction of illumination, whether correct or not. The turning of the page does not help if you also turn the illumination, so to speak. Fatigue of the eye has nothing at all to do with reversal. The eye still shows all the shadows. It is the translation of these shadows by the mind which determines the perspective. Ordinarily the mind does this without our being conscious of the fact, because of long experience.

Let us look at lunar crater Moesting on the back cover of the February issue. With the sun shining in from the left it appears that the shadow is caused by a projection on the moon's surface, which must be the brightly illuminated left side of Moesting, therefore making it a conical mountain instead of a conical crater. As stated in the editorial comment, some objects refuse to reverse because of the unnaturalness, just as an actual mound of a footprint is translated into a depression (which is natural) by changing the illumination mentally.

JOSEPH MATZELLE
Hawleyville, Conn.

Sir:

Tonight, just before I wrote this letter, I was reading the February issue of your magazine. Before picking it up I said to myself about five times that I would try to see if I could invert the bubbles in the picture on page 2. I knew about it before, so I thought I would try it. I opened the magazine and the bubbles were depressions. I've tried it since then again and again but I can't seem to bring it back.

I was reading on my back and the illumination was a 60-watt bulb dimmed with carbon paper rubbed on it. I think it was my very strong will to do it, and the effect of the partially blue light, that made the "bubbles" invert for that second for me.

JOHN GULICK, III
Hillburn, N. Y.

Sir:

By holding the illustration of the lunar craters so that a bright light travels from right to left across the page, the mountains on the right of the craters cast a shadow along the right margin of the valley; but the mountain on the left crater wall is illuminated, without "inversion." When the same illustration is dimly lighted from the left, the crater valley seems elevated because of the shaded part. Shifting the illumination from side to side, the craters appear to change from valleys to hills and from hills to valleys.

When one's eye or the brain center tires of seeing valleys, these parts are rested by regarding the craters as flattened mountain tops. Even without altering the direction of the light, these "mountains" can apparently be changed into craters again, thus resting the "tired" eye or the "weary" brain.

HENRY WINSOR
Haverford, Pa.

Sir:

Reading the comments on image inversion I was greatly relieved to find that the craters on the moon seem to pop out for other people, too. I discovered it first on Plate X.

I made experiments looking at the plates while my eyes seemed wide awake and when they tired after some moments, as Mr. Baldwin described.

I found that I could reverse and bring back the image at will by simply changing the direction of illumination on the plates. It worked in the daytime by having the window to my right or my left. But the best results were at night with a table lamp. If the lamp shines from the right, the same side the sun was shining on the surface of the moon when the photograph was taken, the features appear as they should. But let the light come from the left and the craters appear as plateaus instantly or after a few moments.

Whether my eyes are acute or temporarily tired doesn't seem to affect the result.

ERNEST STRAUB
Detroit, Mich.

Sir:

If I look at the craters right side up, with the desk light to the left, the craters appear as raised areas. If I switch the light to the right, they appear as depressions. If I then turn the picture upside down, the appearance is reversed. Apparently I unconsciously consider the source of light as producing the shadows.

DR. H. A. DOWNEY
Appleton, Wis.

ED. NOTE: Mr. O'Neill's findings may indicate that astigmatism or some other aberration in the observer's eyes may be a factor in many cases. What is the difference in the effect for those who wear and who do not wear glasses? If Mr. Straub noticed it first on Plate X, after nine first-quarter plates, could the reversal of sunlight to last quarter explain the inversion for him?

Amateur Astronomers

PLANS FOR JULY CONVENTION TAKE SHAPE

THE PROGRAM of the annual convention of amateur astronomers, to be held in Philadelphia on Friday, Saturday, and Sunday, July 4th to 6th, is being formulated by a committee representing the Rittenhouse Astronomical Society and the Amateur Astronomers of the Franklin Institute. Some of the convention sessions will be devoted to transaction of business of the Amateur Astronomers League, although the program will be shared among all attending individuals and groups, whether members of the League or not. It is expected that a detailed program will be announced in *Sky and Telescope* next month.

An innovation will be a session for papers to be presented by amateurs. Persons interested in making individual or group reports on any programs of work, devices, instruments, or new wrinkles, are urged to notify the Amateur Astronomers Convention Committee, addressing the committee at the Franklin Institute, Philadelphia 3, Pa.

Reports of the activities of amateur societies throughout the country will be presented at another session, so that there may be discussion of the problems which all such groups encounter. Tours to nearby points of astronomical interest will combine with the regular sessions to fill out a complete schedule for the duration of the convention. An exhibition of photographs, instruments, and other equipment is scheduled, with particular emphasis being placed upon original models and other devices for the demonstration of astronomical principles or for more effective teaching of astronomy.

The Indiana Astronomical Society has joined the Amateur Astronomers League, bringing the list of members to 30.

Twentieth Anniversary Dinner

On Friday, April 18th, at 7:00 p.m., in the Fifth Avenue Hotel, New York City, the Amateur Astronomers Association will hold a dinner in celebration of its 20th anniversary. The guest speakers will be Dr. Jan Schilt, director of Rutherfurd Observatory, Columbia University, and Dr. Peter van de Kamp, director of Sproul Observatory, Swarthmore College. Their topic will be "Twenty Years of Astronomy." Other features are announced as Stellegrams, Jig-star Puzzles, and door prizes. Reservations may be had from the secretary, George V. Plachy, Hayden Planetarium, New York 24, N. Y.

Astronomy in Nashville

In 1928, the Barnard Astronomical Society was organized in Nashville, Tenn., named for the famous Nashville astronomer, Dr. E. E. Barnard. After 10 years in which not a single meeting was omitted, the group became semi-active, with meetings suspended after April, 1941.

Last autumn, Dr. Carl K. Seyfert became director of Vanderbilt University Observatory, and he stimulated revival of the astronomy group. At the first meeting, when Dr. Seyfert lectured on "A Trip Through the Universe," 75 persons attended. This rate of attendance has continued through subsequent meetings, which are now held on the second Thursday of each month at Vanderbilt University.

The president of the club is Dr. Seyfert, with Latimer J. Wilson as vice-president, and Ernie Keller secretary-treasurer. Three of the present members are charter members: Mrs. Roberta D. Lyne, founder and first president, Mr. Wilson, and James A. Dale.

Eastbay Activity Increases

The last four years have been lean ones for the Eastbay Astronomical Society in Oakland, Cal., but we are now taking a new lease on life. Even the weather favored our meeting on January 4th at the home of Mrs. R. Q. Roemer in Alameda, just across the estuary from East Oakland. Our membership is about 90, and, as about half that number were present either as members or guests, we feel we have taken a long step forward.

At that meeting, Miss Elizabeth Neall, our secretary, conducted a questionnaire on astronomy, with pictures, astronomical and otherwise, furnishing the question material. The winner was Franklin Crease, our up-and-coming young astronomer. The writer was second, but by what margin the secretary did not say! After a reel of motion pictures and some refreshments, everyone went home feeling that the association was closer knit than it had been for many years.

GEORGE D. BAIRD
Alameda, Cal.

THIS MONTH'S MEETINGS

Chicago: Dr. Otto Struve, director of Yerkes and McDonald observatories, will speak to the Burnham Astronomical Society on Tuesday, April 8th, at 8:00 p.m. The meeting is at the Chicago Academy of Sciences Auditorium. "The 50th Anniversary of the Yerkes Observatory" is Dr. Struve's title.

Cincinnati: The Cincinnati Astronomical Association will hear a lecture by E. N. Jennison, telescope engineer, Warner and Swasey Company, on "Problems of the Schmidt Camera," at their April meeting. The date is Friday, April 11th, and the meeting place at the University of Cincinnati campus.

Cleveland: "Stellar Pulsations" will be discussed by Dr. Martin Schwarzschild, of Rutherfurd Observatory, at the meeting of the Cleveland Astronomical Society, on April 4th at 8:00 p.m., Warner and Swasey Observatory.

Detroit: The meeting of the Detroit Astronomical Society on Sunday, April 13th, will be in the form of an Astronomical Information Please, with William Schultz, Jr., of the Cranbrook Institute, as master of ceremonies. The meeting is at 3:00 p.m. at Wayne University. Members and guests are asked to send their questions in advance to Mr. Schultz, at the Cranbrook Institute of Science, Bloomfield Hills, Mich.

Geneva, Ill. At the April 15th meeting of the Fox Valley Astronomical Society, the Rev. Frank Hancock will speak on "The Milky Way Galaxy." Meeting place is the Geneva City Hall, and the lecture is at 8 o'clock.

Indianapolis: "Sky Information Please" will be conducted by the board of officers at the Indiana Astronomical Society meeting this month, April 6th at 2:15 p.m., Odeon Hall.

Kalamazoo: On Saturday, April 26th, the Kalamazoo Amateur Astronomy Association will meet at the home of Mr. and Mrs. Leonard Hayden, where James Sigler will speak on "The Large Telescope."

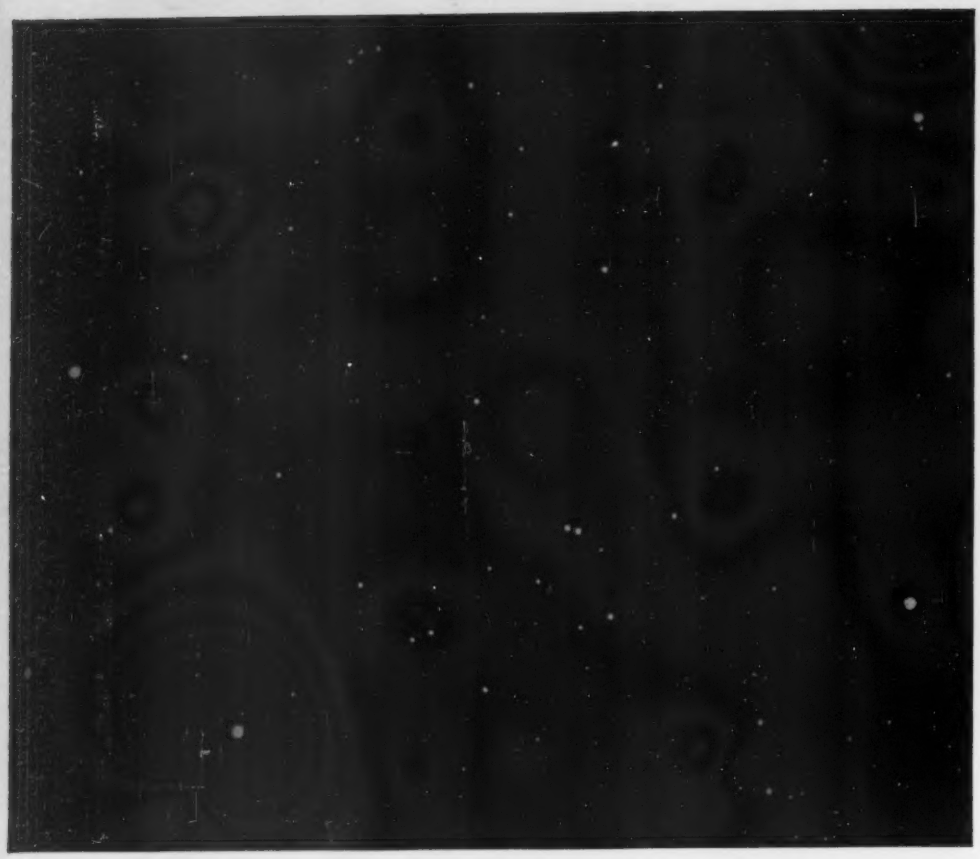
Madison: At the meeting of the Madison Astronomical Society on April 9th, H. B. Porterfield will speak on "Naked-eye Astronomy," at the Washburn Observatory.

New York: "How Old Is the Universe" is the lecture topic of Dr. Bart J. Bok, of Harvard Observatory, speaking at the Amateur Astronomers Association meeting on Wednesday, April 2nd, at 8:00 p.m. in the American Museum of Natural History.

Philadelphia: The speaker for the meeting of the Rittenhouse Astronomical Society, April 11th at 8:00 p.m., will be Dr. Samuel Barton, of the Flower Observatory, who will lecture on "The Moon." The meeting will be held in the Morgan Physics Laboratory, University of Pennsylvania.

Pittsburgh: On Friday, April 11th, the Amateur Astronomers Association of Pittsburgh will hold its annual quiz program at the Buhl Planetarium. Chester Clark, of Station WCAE, will act as quiz master. There will be numerous prizes, and refreshments following the meeting, which begins promptly at 8:00 p.m.

Washington: Professor Leah B. Allen, of Williams Observatory at Hood College, will speak at the regular monthly meeting of the National Capital Astronomers on Saturday, April 5th, at 8 o'clock in the Commerce Department Auditorium. The subject of Miss Allen's talk will be, "Men, Women and Stars."



The region of the bowl of the Big Dipper, with the Pointers on the right. This exposure of an hour with a Ross camera reveals many stars not visible to the naked eye.

THE EASTER

By Cathar[illegible] E.

If the stars should appear one night in a thousand years, how would men believe and adore; and preserve for many generations the remembrance of the city of God which had been shown!
— Ralph Waldo Emerson

ONE MIGHT SPEAK of the earth as parading in her most beautiful dress at this season of the year. Flowers, birds, insects, and the new shoots of emerald grass are the embellishments of the dress. And to top off this fine raiment, she wears a new Easter bonnet, for the spring sky is, figuratively speaking, just that — a bonnet which is trimmed with scintillating stars, star clusters, nebulae, galaxies, and those ever-sparkling jewels, the colorful planets.

As certainly as nature will change her terrestrial dress, so will she change her "bonnet." We do not see the same evening stars in the winter that we do in the summer or the same in the spring that we do in the fall. The sky picture is ever changing due to the earth's revolution about the sun. Our brother and sister planets, too, are constantly shifting their positions against the background of stars, nestling first in one constellation and then in another, depending upon their orbital speeds.

During the first part of April this year, Saturn, the ringed planet, leaves the celestial panorama about midnight whereas Jupiter, now at maximum brilliancy, remains prominent in the southern sky for the remainder of the night. And before the dawn of each new day this month, Venus makes her bow as a morning star, and is visible low in the southeast at sunrise.

We probably all can boast that we have taken part in some terrestrial parade, although perhaps only as onlookers, but I fear relatively few can say that they ever joined the Easter parade of the stars. Get in step! This is the season (it's not too hot nor too cold) to begin stargazing if you haven't done so before.

The Big Dipper is usually listed as a spring star group and, certainly, is one that every inhabitant of the Northern Hemisphere should be able to recognize. It is in a most advantageous position for observation in the early evening at this time of year. At about 9 p.m. local time, on the 15th of April, the two Pointers at the front of the bowl are almost above the North Star and, of course, pointing directly to it. The curved handle of the Dipper extends off to the east.

The amateur astronomer will find it helpful to remember that the Pointers, Merak and Dubhe, are about 5½ degrees apart. This span between the two stars may be used as a measuring rod to estimate the distance between other stars.

The Big Dipper, a part of the very ancient constellation Ursa Major, the Larger Bear, is a circumpolar group in latitude 40° north and north of this, always remaining above the horizon during any time of day or night. The altitude of the North Star is an indication of your latitude, as its altitude is always equal to the latitude from which it is observed.

We see the Big Dipper in changing relation to the North Star at the same hour of the evening at different seasons: below the pole in the autumn; standing more or less on the tip of its handle in the eastern sky in the winter; above Polaris in the spring; and to the west of the pole star, resting on the end of the bowl, handle upward, in the summer.

The Little Dipper in Ursa Minor, the Smaller Bear, is not as easily located as the Big Dipper. The stars forming this configuration are not so conspicuous. It may help you in finding it to know that the handle of the Little Dipper bends the other way from the handle of the Big Dipper.

Historically, Ursa Minor is of considerable interest. It wasn't authoritatively accepted as a constellation by the Greeks until about 600 B.C. It was Thales who persuaded them that, as a navigation group, it had superiority over Ursa Major. Up to this date, the Big Dipper had been commonly used in that part of the world as a guide to mariners. Because their attention was first called to this constellation by the Phoenicians, the Greeks sometimes called it Phoenice. It was more often called Cynosura, which may be the origin of our English word cynosure, meaning "an object of general interest or attention."

Perhaps, the constellation thought of as the most outstanding of the spring sky is Leo, the Lion. He is very easy to locate with the aid of the Pointers. Draw a line from Dubhe to Merak and on, away from the pole star but as far as

AD ASTRA

I march to hidden music, song of spheres
And roll of constellations in my ears.
The clouds surrender first, and in retreat,
Fling wide the starry carpets for my feet.
I capture far horizons; flaming skies
Grow pale before the knowledge in my eyes.
I march to hidden music. Only they
Who seek the absolute may walk this way.

Kathleen O'Byrne Grece

TER STAR PARADE

HARRIE E. BARRY, *Hayden Planetarium*

to it. This will bring you into the middle of Leo. To the west of this line you will perceive a group of stars resembling a sickle or a question mark in reverse, one of the most easily recognized asterisms in the spring sky. At the base of the handle of the Sickle is the 1st-magnitude star, Regulus, which is the faintest of the 20 stars of the 1st magnitude. To locate the tip of Leo's tail, sight east of the line drawn to locate the Lion, and you will discover a right-angle triangle of 2nd-magnitude stars. Denebola, the tail of the Lion, is the easternmost star.

If you will draw a line from Gamma Leonis, the brightest star in the blade of the Sickle, through Regulus and extend it southward twice that length, you will discover Alphard, the brightest star of Hydra, the Water Monster. This star has been known as "the lonely one" because it seems isolated in an area of the sky where there are only faint stars. The head of the monster can be found just below Praesepe.

One cannot account for the spring constellations without mentioning Gemini and Auriga. If you have any doubt as to their appearance or position in the sky, refer to the star chart on page 24. The Twins can be easily identified by drawing a line from Alkaid, the star at the end of the handle of the Big Dipper, to Merak, one of the Pointers, and extending it about one and one half times as far again, which brings you to the 1st-magnitude star, Pollux. Just west of Pollux is Castor, the second of the heavenly twins. Although Pollux is the brighter of the two stars, Castor is Alpha while Pollux is Beta in the constellation. Castor itself presents one of the most interesting multiple star systems in the sky. What is to the naked eye a single star appears as three with the aid of a telescope, and when the light from these three stars is analyzed by a spectrograph, each one of them is found to be double. Actually there are six stars in the Castor system.

This is a photograph of the great globular cluster M3, in Coma Berenices, which rivals the cluster in Hercules as an object for amateur telescopes. This photograph, taken in red light, brings out many of the red giant stars in the cluster.

The Coma Berenices cluster.

Auriga, a five-sided group of stars, is in the western evening sky with Gemini, only much to the north of it. Capella, in Auriga, is the fifth brightest star in the sky, and brilliant yellow. You can be sure that you have located Capella if you can sight three fainter stars forming a triangle close to it. Capella is the "Little She-Goat," and the three stars of the triangle are called the Kids.

One of the most beautiful star clusters faintly visible to the naked eye is Coma Berenices. The constellation lies almost wholly within the triangle formed by Denebola in Leo, Arcturus in Bootes, and Cor Caroli in Canes Venatici (once again refer to the star chart). In *Star Names and Their Meanings,* by R. H. Allen, Garrett P. Serviss is quoted as saying that it has "a curious twinkling, as if gossamers spangled with dewdrops were entangled there. One might think the old woman of the nursery rhyme who went to sweep the cobwebs out of the sky had skipped this corner, or else that its delicate beauty had preserved it even from her housewifely instinct." It is not easy for the untrained eye to detect any of the individual stars in the cluster, except perhaps Alpha, Beta, and Gamma, 4th-magnitude stars.

The legend of Coma Berenices is that of a great queen of ancient Egypt, Berenice, a lady of indescribable beauty, who was the wife of Euergetes, a king of Egypt. When it was required that the king depart upon a particularly perilous journey, Queen Berenice vowed to the gods that if Euergetes were safely returned to her, she would sacrifice the beautiful tresses for which she was renowned. When the king returned from his warlike mission, Berenice was true to her vow; she had her precious locks shorn and placed upon the altar in the temple of Venus. During the night the sacrifice was stolen. However, when the royal astronomer was called in, he was confident, as he pointed to the beautiful clustered stars of which we are speaking, that they were the tresses of Queen Berenice, transported into the sky by Venus herself as an eternal memorial to the great sacrifice and beauty of the queen.

The Coma star cluster is one of the nearest galactic clusters, about 250 light-years away. The north galactic pole is located in this region, and so the absence of bright stars in this area is more than compensated for by an abundance of galaxies. Also, there are several fine globular clusters in this part of the sky, such as M3 and M53.

We have not reviewed the whole parade as yet, nor half of it. Go out tomorrow night and the night after and every clear night for a month or two or three, and then you will be able to boast that you have seen the Easter parade of stars.

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BOOKS AND THE SKY

ATOMIC ENERGY IN COSMIC AND HUMAN LIFE

G. Gamow. The Macmillan Company, New York, 1946. 161 pages. $3.00.

THOSE who have followed with enjoyment the adventures of Dr. Gamow's Mr. Tompkins among the atoms, quanta, and oscillating universes will not be surprised to find in **Atomic Energy in Cosmic and Human Life** an equally engaging introduction to the complexities of atomic nuclei and energy generation.

This time, without the assistance of the bewildered bank clerk, but with the same deftness of expression that characterized previous volumes, the author presents us in the first chapter with a graphic explanation of the significance of metastable energy states, and a brief historical account of atomic theories and atom smashers. The real core of this chapter is the description of the author's important theory of the nucleus as a fluid droplet, and his interpretation, in terms of this hypothesis, of the activation-energy of nuclear fusion and fission and the resulting liberation of energy. The 40-odd sketches in this and the two remaining chapters, and such well-chosen examples as the parallel between the surface tension of a soap film and the cohesive forces of an atomic nucleus, not only illustrate the arguments, but considerably enliven the reading.

Chapter II, "How the Stars Use Atomic Energy," is the best exposition of stellar energy generation within reach of the reader untrained in nuclear affairs. Together with the first chapter it provides ample reason for recommending this title to all of an astronomical turn of mind. In addition to the carbon-nitrogen cycle, the questions of the relative abundances of different nuclei and the initial stages of an explosively expanding universe are given the benefit of Dr. Gamow's illuminating style of presentation.

The final chapter, which occupies nearly half of the book, is devoted to the theoretical problems and production methods involved in the release of nuclear energy by and for mankind. (Readers will enjoy the instructions on pages 147 and 148 for constructing an atomic bomb in the home workshop.) Whoever thoroughly digests this chapter will find himself much better prepared to follow such accounts of nuclear research as the Smyth report, not to mention the debates in the current press on national and international control of atomic developments. The final pages include some interesting speculations on means of utilizing atomic energy in commercial power plants and for interplanetary travel.

Professor H. N. Russell's introduction, with its warning against carefree squandering of available energy sources, could well be read a second time before the book is laid down.

FREEMAN D. MILLER
University of Michigan Observatory

THE PATH OF SCIENCE

C. E. Kenneth Mees. John Wiley and Sons, Inc., New York, 1946. 250 pages. $3.00.

THE DEVELOPMENT of science was the subject of the Hitchcock lectures given at the University of California in 1943 by Dr. C. E. K. Mees, vice-president in charge of research, Eastman Kodak Company. In the present book, these lectures have been expanded "with the purpose of presenting the development of modern science against the background of history." Dr. Mees, a chemist by training, is worth listening to because he has made an outstanding success in applying research to the manufacture of photographic emulsions and because he enjoys a wide range of contacts in science and industry.

Although largely historical, the book has a forward look; the past is scanned for movements which may aid in interpreting the present and in planning the future. On a page by itself is a quotation from Joan Evans, "The present should retain its true

THE EDITORS NOTE

(Continued from page 2)

special paper. This releases exactly the right amount of developer, hypo, and other chemicals necessary to develop and print the picture. The outer surfaces of the film and paper are, of course, light tight, and no darkroom is necessary.

In developing negatives by conventional means, the developer causes the deposition of metallic silver wherever light has activated the original silver halide crystals. Hypo dissolves the unexposed crystals and washes them away. Then the process must be repeated to make a positive print. In the Land camera, both hypo and developer go to work at once. The exposed crystals are turned into silver and kept within the film, out of circulation, but the silver crystals from the unexposed areas are taken into solution by the hypo. Then they are developed and the silver is deposited on the paper to form the positive. Other chemicals in the mixture in the pod control the size of the grains, the color of the print (black-and-white, sepia shades), and make the process work over a wide range of temperatures (from about freezing to 110° F.).

Amateur astronomers interested in photographing the moon and the sun, eclipses and meteors, will find the process a boon, and it should have some applications in professional astronomy, although its use on glass plates has yet to be tried. On an eclipse expedition to a region where fresh or running water is unavailable, or where a darkroom is difficult to set up and maintain, the Land process would insure immediate and carefree development.

First demonstrated on February 21st at the New York meeting of the Optical Society of America, the new Polaroid development is described in detail in the February issue of that society's **Journal.** Mr. Land outlines four different classes of processes to produce a positive print in one operation, and presents characteristic curves and other technical data. He notes that there are no references to an instantaneous system of photography, even as ideal, in the extensive literature on photography.

proportion — a moment between an infinite past and a hurrying future."

The gradual development of tools and processes in the growth of human civilization is treated at some length; and the accelerating dominance of the scientific method is emphasized. In a symbolic frontispiece, the theory of cycles and the varying rate of progress are illustrated by a spiral spring, partially extended, seen against an inverted cone of light. The reviewer confesses concern lest the upper end of the stretched spring slip from the fingers of the unseen manipulator, whereupon the expanding coils presumably would collapse, and science would be set back many centuries.

The most strictly factual portion of the book consists of chapters on the history of physics, of chemistry, and of biology (the last by Dr. John R. Baker of the University of Oxford, England). These chapters should give the studious lay reader considerable insight into many ideas important in modern science. The great astronomical triple play — Tycho to Kepler to Newton — is briefly described. The few pages on astrophysics might stimulate further reading.

In chapters devoted to the organization of present-day research, the problems and potentialities of universities, special research institutes, and industrial laboratories are thoughtfully intercompared. This section should be profitable to those who plan or administer research. The relationship of science and technology to sociology and politics is discussed in the last chapter.

Numerous references to other writers on science and research, with short quotations, are scattered through the book. Of special interest are penetrating comments by Dr. Mees himself, for example: "The most important advances in science will continue to be unexpected, improbable, and even unpalatable, and it is essential that the men who are to make them should not be prevented from doing so."

PAUL W. MERRILL
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SKY PUBLISHING CORPORATION

SCIENCE SINCE 1500

H. T. Pledge. Philosophical Library, New York, 1947. 359 pages. $5.00.

THANKS to the wise choice of a starting point, 1500 A. D., here is a history of modern science with a thoroughness lacking in the nearest comparable treatises. That the author has the courage, or rashness, to carry the narrative right down to the problems facing scientists today (about 1938 for most fields) greatly enhances reader satisfaction. Mr. Pledge, librarian of London's celebrated Science Museum, "is keenly aware that his account of recent years can be but a reflection of his personal tastes," but more bashful scholars have almost always left the reader to his own devices after 1900 or even after 1850.

"A Short History of Mathematics, Physics, Chemistry and Biology" is the subtitle of Mr. Pledge's story of the building of modern science. Astronomy would appear to be left out, but this is not the case. The allotted space, some 12 per cent, is adequate in view of the number of workers in the field.

The wealth of material in these 359 pages is made possible by the suppression of much of the philosophical and social influence of science. Technology is also sparingly treated. This results in meatier reading than Dampier's well-known **A History of Science**, and those allergic to mathematics may be somewhat dismayed at the chapters on its development.

The astronomy enthusiast will, however, be far happier with **Science Since 1500** than with the more diffuse works. The organization is excellent; the chapters are short and the interdependence of the different fields of knowledge is skillfully shown. It is too much to expect to find a history of astronomy in this compass, but the relation of the "queen of the sciences" to her younger subjects is set forth with the conviction born of the author's demonstrated mastery of his business.

This admirable volume is well gotten up, with 15 plates, and 12 maps, graphs, and charts all showing a refreshingly original approach. At the end is a useful index giving the dates of each scientist.

Many readers will be stimulated to look in the bibliography for books covering their own interests more fully. Here the amateur astronomer, and the professional, will be disappointed. Of four books named, one is controversial, another stops at 260 B. C., one carries a single topic down to 1619 A. D. (and is unobtainable), while the fourth treats a century of astrophysics with chilling heaviness.

For the history of astronomy, the only volume which can be recommended without qualification is still Agnes Clerke's famous **A Popular History of Astronomy in the 19th Century.** Her condensed exposition of the whole subject, in the **Encyclopaedia Britannica,** is a miniature classic. More recent history and the present status of the science are best learned from a standard text.

The amateur's fullest enjoyment of his hobby may well come from a textbook for facts, Clerke for the story and **Science Since 1500** for background, plus **Sky and Telescope** for the latest developments.

J. W. STREETER
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Two Cameras Contrived by Amateurs

ENCLOSED is a diagram of a lens combination which I worked out from some of the lenses advertised in recent issues of **Sky and Telescope.** The triplet of thin lenses seems to furnish satisfactory results in photography of the night sky, also in cloud photography. A field of approximately 81 degrees can be obtained on a frame 42 x 60 millimeters. I use a 6.5 x 9 cm. film size, and get two pictures on each film, a help in times of film scarcity. The lens diameter is 30 mm. and the focal length of the objective is 35.5 mm. Of course, the full aperture can-

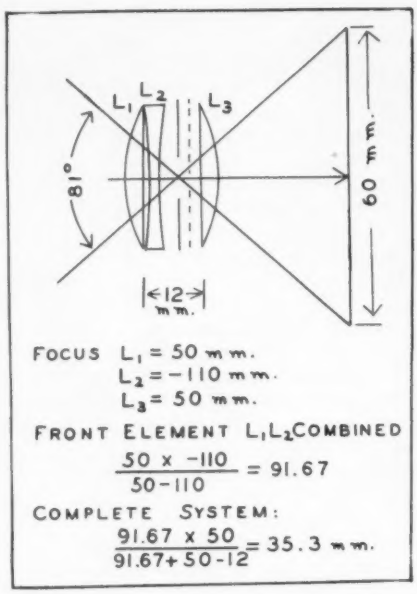

Diagram and focal length computations of an inexpensive wide-angle camera lens made from simple lens elements.

not be used to cover the 60-mm. frame, but for night work, I get star trails to about the 6th magnitude.

The plano-convex lenses are 30-mm. diameter, 50-mm. focal length, and cost one dollar each. These are remarkable lenses in that they are so thin and are apparently so nearly achromatic. The negative lens I use is probably a white crown; I do not know its index of refraction or its dispersive power. Yet when it is used as shown in the diagram it seems to produce satisfactory color correction. I tested it with tri-color filters, that is, the complete photographic ob-

Clouds in a July sunset, photographed with Mr. Wilson's inexpensive camera.

GLEANINGS is always ready to receive reports and pictures of amateur instruments and devices, and is open for comments, contributions, and questions from its readers.

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jective system, and the colors are very nearly in perfect adjustment, the red being only a little out of focus in the central area. This is corrected by reducing the aperture and slightly lengthening the focal distance. The negative element was purchased from a local optician for 75 cents, to make the total cost of my photographic lens $2.75!

The arrangement of the triplet is an adaptation of the Cooke design. The front lens, however, is in contact with the rim of the symmetrical double concave component. I am not an experienced lens designer, my optical experience consisting in the making of five concave telescope mirrors. The best of these is the 12-inch f/8 mirror which I am now using. I find, however, that experimentation in matching odds and ends of lenses is an interesting undertaking which can prove useful, as in the present instance.

LATIMER J. WILSON
1606 Woodland St.
Nashville, Tenn.

NEWS OF THE SUNSPOT of February 3, 1946, made me want to photograph it for the sheer satisfaction of keeping a record of my own of that remarkable phenomenon. My digging into drawers and boxes for spare parts and forgotten pieces of my abandoned telescope gradually became a frantic struggle against time. I won at last, shooting at 3:00 p.m., shortly before the sun hid behind the clouds—even daring to use cumulus for want of a filter. But the results were poor until I borrowed a red filter which gave partial success on February 7th.

Then I changed the original 9 x 12 cm.

Circumpolar star trails, reaching all the way from the Big Dipper handle (upper left in lower picture) to a star in Cassiopeia (extreme lower right of lower picture). The curved streaks are fireflies.

HAINES UNIVERSAL TELESCOPE MOUNTINGS

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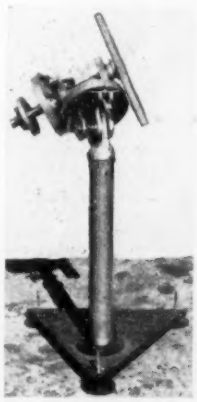

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Circles enable you to find instantly any of the thousands of unique stars and galaxies that are invisible to the naked eye, as well as Neptune, Uranus, and Pluto.

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Model No. 5. TEACHERS' MODEL for Schools $245.00

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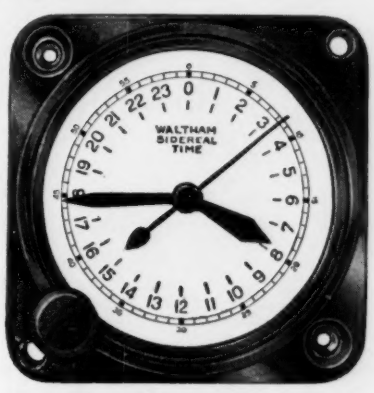

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14 mm Dia.	60 mm F.L. coated,	ea.	1.25
18 mm Dia.	102 mm F.L.	ea.	1.25
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23 mm Dia.	184 mm F.L.	ea.	1.25
25 mm Dia.	122 mm F.L. coated,	ea.	1.25
26 mm Dia.	104 mm F.L. coated,	ea.	1.25
29 mm Dia.	54 mm F.L. coated,	ea.	1.25
29 mm Dia.	76 mm F.L. coated,	ea.	1.25
31 mm Dia.	124 mm F.L. coated,	ea.	1.50
31 mm Dia.	172 mm F.L. coated,	ea.	1.25
32 mm Dia.	132 mm F.L.	ea.	1.50
34 mm Dia.	65 mm F.L. coated,	ea.	1.50
38 mm Dia.	130 mm F.L.	ea.	1.50
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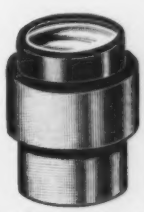
58 mm Dia.	215 mm F.L.	ea.	4.50



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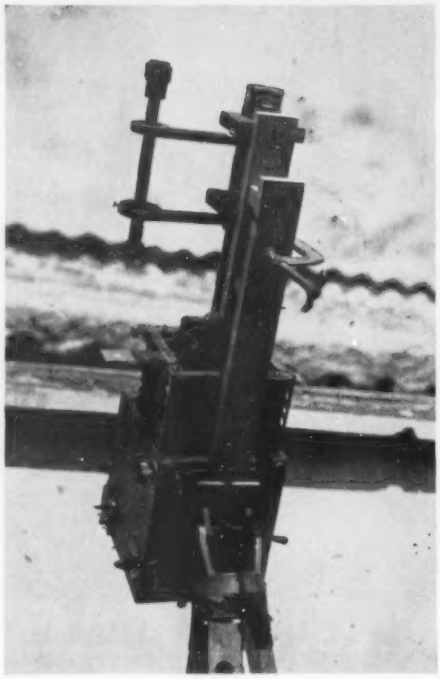

The solar telescope and finder put together by Mr. Diaz from old telescope parts and a Graflex camera. The sun's image is projected by the finder.

camera which I had used for an old 5 x 7-inch Graflex; this allowed me to place the film at a greater distance from the scope's ocular. The focal length of the photographic enlarging lens I used as an objective was 14 inches, that of the eyepiece ¾ inch. I also installed a finder telescope which can be seen beside my "great" refractor, projecting a solar image on a small screen. Satisfactory images 2½ inches in diameter were then obtainable.

Between the Graflex and the scope I attached a 1/300-second B&L Optimo shutter — still reliable after 20-odd years — and made on February 8th, with this "sturdy, precision-built apparatus," the best portrait of all of this sunspot. Thus began and ended my first venture in solar photography.

JULIO MARIO DIAZ
Caracas, Venezuela

This print of the sunspot of February 8, 1946, is slightly enlarged from contact size. The picture was taken with Mr. Diaz's camera.

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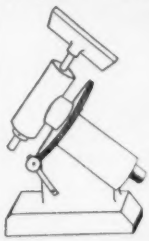

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FOR SALE: 8″ R. F. T. pyrex telescope mirror, 33″ f.l., aluminized, $60.00. Eugene Alexander, 1178 Queen Anne Place, Los Angeles 6, Cal.

FOR SALE: 4.25″ refractor, custom built by Ferson; with 2″ finder, star diagonal, 2 eyepieces. NO MOUNT. Condition like new. Price $300.00. WILL TRADE: good copy of Pickering's "Photographic Atlas of the Moon" for a copy of "The Moon" by Goodacre. Robert Doubleday, 227 Midland Ave., East Orange, N. J.

FOR SALE: 8″ pyrex glass partly ground, with glass tool and book ATM. R. E. Hiland, 117 Warren Ave., Boston 16, Mass.

FOR SALE: 2½″ refractor. Excellent condition, altazimuth mounting and tripod. 2 astronomical eyepieces, star diagonal. $200.00. Photos on request. A. E. Hopkins, Box 311, Lexington, Mich.

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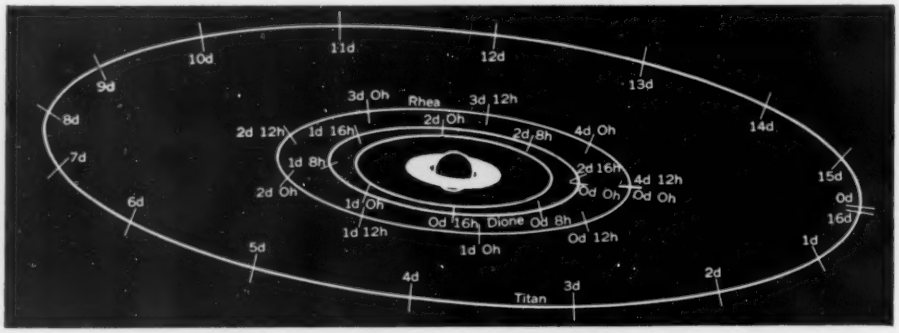
OBSERVER'S PAGE

Greenwich civil time is used unless otherwise noted.

SATURN'S SATELLITES MAY BE FAVORABLY OBSERVED

AS SATURN'S RINGS close this year from an angle of 18° to 13° to the line of sight, the orbits of its satellites appear more flattened. From the **American Ephemeris** we reproduce a portion of a chart showing the apparent orbits as seen at opposition in January this year. South is at the top and the motion is clockwise, as in an inverting telescope. The orbits of Saturn's four brightest satellites are shown. Tethys, magnitude 10.5, is innermost; then come Dione, 10.7; Rhea, 10.0; and Titan, 8.3. Their synodic periods are, respectively, $1^d\ 21^h.3$, $2^d\ 17^h.7$, $4^d\ 12^h.5$, $15^d\ 23^h.3$.

On this chart, the eastern elongation points are marked **0d**, and the satellites occupy them at the times listed below.



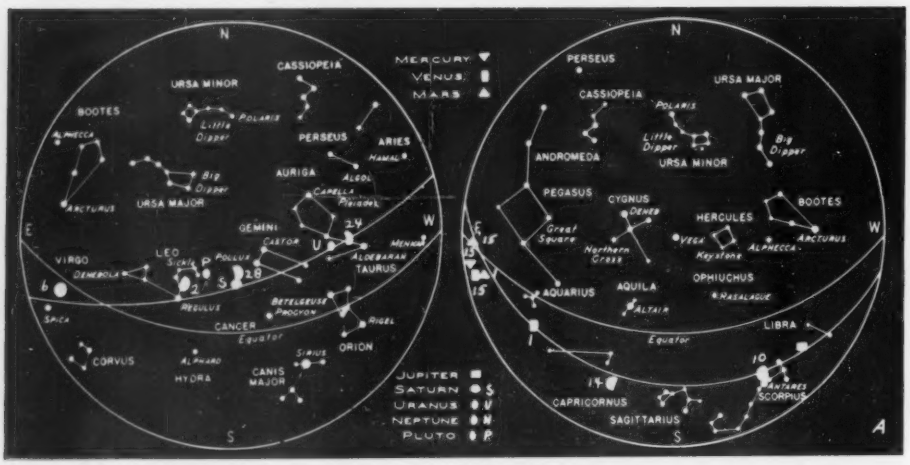
For any time of observation, apply the interval since the preceding elongation to the intervals marked on the respective orbits. The dashes in the table indicate that one or more elongation times have been omitted, for instance, Tethys has 16 elongations this month. By the use of the synodic periods, times for elongations can be extrapolated into May.

Titan should be easy to locate with a small telescope, the others requiring more careful search. Titan is at eastern elongation at $2^h.6$ on April 11th, and at $1^h.8$ on the 27th. Its western elongations occur at $20^h.2$ on April 2nd, and at $19^h.1$ on the 18th.

Tethys		Dione		Rhea	
2^d	$2^h.3$	3^d	$17^h.2$	2^d	$20^h.1$
3	23.6	6	10.9	7	8.5
—	— —	—	— —	—	— —
15	27.5	17	9.7	16	9.4
—	— —	—	— —	—	— —
24	18.1	25	14.8	25	10.4

Satellite Iapetus, magnitude 11.0, with a synodic period of $79^d\ 22^h.1$, has an orbit about three times as large as that of Titan. Iapetus passes through inferior conjunction, about 60″ north of Saturn's center, on April 11th at $18^h.3$. It reaches western elongation on April 30th at $18^h.1$, when it is over 500″ west of Saturn.

THE MOON AND PLANETS IN THE EVENING AND MORNING SKIES



In mid-northern latitudes, the sky appears as at the right at 5:30 a.m. local time on the 7th of the month, and at 4:30 a.m. on the 23rd. At the left is the sky for 7:30 p.m. on the 7th and 6:30 p.m. on the 23rd. The moon is shown for certain dates by symbols which give roughly its phase. Each planet has a special symbol, and is located for the middle of the month, unless otherwise marked. The sun is not shown, although at times it may be above the indicated horizon. Only the brightest stars are included, and the more conspicuous constellations.

Mercury, a morning object all month, reaches greatest western elongation on April 5th. The stellar magnitude is then +0.5, and the planet is 27° 48′ from the sun. This is extremely close to the greatest possible elongation, but, because of its southerly position with respect to the sun, Mercury rises less than an hour before sunrise. Aphelion, the position in its orbit when a planet is farthest from the sun, is reached one hour after elongation.

Venus, also in the morning sky, rising one hour before the sun, is no longer a prominent object. The magnitude has decreased to −3.5, and the planet is in the gibbous phase.

Mars. On the morning of April 19th, Mars, Mercury, and the crescent moon will be in conjunction. Close scrutiny may reveal all three objects. The moon will pass south of both Mercury and Mars, nearer Mercury. Venus will be 10° above this configuration. Except for this occasion, Mars is rather difficult to view all month.

Jupiter, now the dominant object in the night sky, rises increasingly earlier in the evening sky through the month. The planet is slowly retrograding in Libra. Its magnitude is −2.0. Jupiter presents a disk 43″ across, which can be detected in field glasses. On the evening of the 8th, the moon and Jupiter will rise together in close proximity.

Saturn remains all month about 10° east of the Twins. It is slightly brighter than Procyon, both objects appearing as yellowish stars.

Uranus will set four hours after the sun, and hence may be seen only in the evening. Its position on the 15th is $5^h\ 11^m$, +23° 4′, and it is of 6th magnitude, requiring some optical aid for finding it.

Neptune may be found with telescopic aid during most of the night. Opposition was on March 31st, and the planet's magnitude is +7.7. On the 15th, Neptune will be at $12^h\ 36^m$, −2° 9′, about 1° southwest of Gamma Virginis. E. O.

METEORS

The Lyrid meteors may be seen about April 21st in the late evening and morning hours. The rates will be about 10 per hour. This is above rates obtainable for other showers during the first six months of the year, except for the Quadrantids in January. The sky will be devoid of the moon, which is new. Lyrid meteors will be seen to a lesser extent for some days before and after the maximum. The radiant is 10° west of Vega, and swift meteors, not bright, are typical. E. O.

DATES OF EASTER

Easter falls on April 6th this year, as it will in 1958, 1969, and 1980, according to the **Handbook** of the British Astronomical Association, where Easter dates are published to the end of the century. In 1948, Easter will be on March 28th, on April 17th the following year, and on April 9th in 1950.

PHASES OF THE MOON

Full moon	April	5, 15:28
Last quarter	April	13, 14:23
New moon	April	21, 4:19
First quarter	April	27, 22:18
Full moon	May	5, 4:53

OCCULTATION PREDICTIONS

Three rather bright stars, Eta Leonis, Nu Virginis, and Phi Sagittarii, are occulted this month, but the three events cannot be favorably observed at any one station, although prediction times are given for them at stations C and E. The observer must take into account interference by daylight and the position of the moon with reference to the horizon for his location. It is always well to check the prediction times with those of local sunrise, sunset, moonrise, and moonset.

April 1-2 **Eta Leonis** 3.6, 10:04.4 +17-01.3, 9, +55° −23° Im: **C** 3:22.2 −3.3 +1.4 64°; **E** 2:46.2 −2.2 +0.5 86°; **F** 2:35.5 −1.9 −1.3 129°; **G** 2:22.5 −1.3 +3.2 58°; **H** 1:56.1 −1.2 0.0 118°. Em: **C** 4:03.6 +0.3 −4.1 357°; **E** 3:53.4 −1.0 −2.5 332°; **F** 3:59.1 −2.2 −0.9 290°; **H** 3:10.9 −1.7 +0.2 285°.

2-3 **BD +12° 2284** 6.4, 10:56.9 +11-59.4, 10, +55° −27° Im: **A** 2:23.4 −3.0 +2.3 64°; **C** 2:06.9 −2.2 +0.7 89°; **D** 2:07.6 −2.4 +1.9 72°; **E** 1:41.9 −1.5 +0.6 100°; **F** 1:34.9 −1.2 −1.2 140°; **H** 1:12.2 −0.5 +0.2 119°.

3-4 **Nu Virginis** 4.2, 11:43.1 +6-49.6, 11, +56° −28° Im: **A** 23:06.3 −0.5 +0.9 104°; **C** 23:01.8 −0.4 +0.4 117°; **E** 22:59.2 0.0 +0.6 111°.

7-8 **26 Librae** 6.3, 15:11.6, −17-34.3, 15, +73° +17° Em: **A** 10:23.4 −1.2 −1.5 281°; **C** 10:22.6 −1.4 −1.3 276°; **E** 9:56.9 −2.1 −0.9 271°; **F** 9:37.8 −4.4 +1.8 237°; **G** 9:05.5 −2.0 +0.7 258°; **I** 8:40.9 ... ... 233°.

8-9 **10 G Scorpii** 5.9, 15:54.6 −20-49.9, 16, +70° +3° Em: **A** 5:25.3 −1.7 +1.0 270°; **B** 5:26.5 −1.5 +0.9 276°; **C** 5:11.1 −2.2 +2.1 250°; **D** 5:15.1 −1.6 +1.6 261°.

11-12 **Phi Sagittarii** 3.3, 18:42.3 −27-02.8, 19, +63° +17° Im: **C** 11:10.6 −2.4 −0.7 105°; **E** 10:38.0 −2.2 +0.1 104°; **F** 10:24.7 −2.0 −0.7 128°; **H** 9:58.5 −0.2 −0.7 145°. Em: **C** 12:36.5 −1.5 −0.3 245°; **E** 12:09.7 −2.2 −0.1 256°; **F** 11:47.6 −2.9 +1.1 239°; **H** 10:55.8 −2.5 +2.3 234°.

25-26 **37 Geminorum** 5.8, 6:52.1 +25-26.6, 5, +90° +25° Im: **D** 4:37.4 +0.4 −1.4 109°; **G** 4:28.9 −0.1 −2.4 135°; **I** 4:32.7 +0.1 −3.4 152°.

For selected occultations (visible at three or more stations in the U. S. and Canada under fairly favorable conditions), these predictions give: evening-morning date, star name, magnitude; right ascension in hours and minutes and declination in degrees and minutes, moon's age in days, limiting parallels of latitude, immersion or emersion; standard station designation, GCT, a and b quantities in minutes, position angle; the same data for each standard station westward.

Longitudes and latitudes of standard stations are:

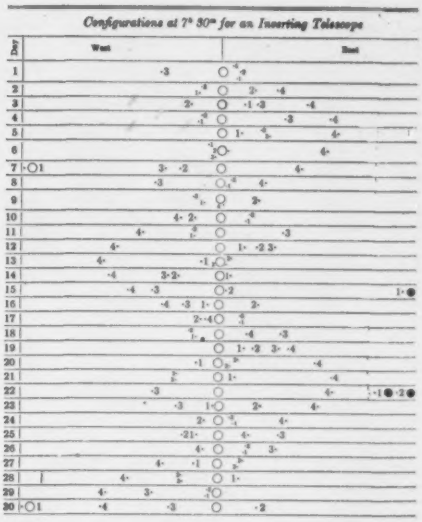
A +72°.5, +42°.5	**E +91°.0, +40°.0**
B +73°.6, +45°.6	**F +98°.0, +30°.0**
C +77°.1, +38°.9	**G +114°.0, +50°.9**
D +79°.4, +43°.7	**H +120°.0, +36°.0**
	I +123°.1, +49°.5

The a and b quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude respectively, enabling computation of fairly accurate times for one's local station (long. Lo, lat. L) within 200 or 300 miles of a standard station (long. LoS, lat. LS). Multiply a by the difference in longitude (Lo — LoS), and multiply b by the difference in latitude (L — LS), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Greenwich civil time to your own standard time.

For additional occultations consult the American Ephemeris and Nautical Almanac and the British Nautical Almanac, from which these predictions are taken. Texas predictions were computed by E. W. Woolard and Paul Herget.

JUPITER'S SATELLITES

Jupiter's four bright moons have the positions shown below for the GCT given. The motion of each satellite is from the dot to the number designating it. Transits of satellites over Jupiter's disk are shown by open circles at the left, and eclipses and occultations by black disks at the right. Reproduced from the American Ephemeris and Nautical Almanac.



VARIABLE STAR MAXIMA

These predictions of variable star maxima are made by Leon Campbell, recorder of the AAVSO, Harvard College Observatory, Cambridge 38, Mass. Serious-minded observers interested in making regular telescopic observations of variable stars may write to Mr. Campbell for further information.

Only stars are included here whose mean maximum magnitudes, as recently deduced from a discussion of nearly 400 long-period variables, are brighter than magnitude 8.0 Some of these stars, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the predicted magnitude, and the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern).

April 2, R Octantis, 7.9, 055**86**; 7, RU Sagittarii, 7.2, 195**142**; 10, RR Scorpii, 6.0, 165030a; 14, RT Sagittarii, 7.9, 201**139**; 20, RS Cygni, 7.4, 200938; 23, R Lyncis, 7.9, 065355; 24, T Centauri, 6.1, 133**633**; 29, R Corvi, 7.6, 121**418**; 29, V Ophiuchi, 7.5, 162**112**. May 5, R Cancri, 6.8, 081112; 7, RS Librae, 7.7, 151822.

GREENWICH CIVIL TIME (GCT)

TIMES used on the Observer's Page are Greenwich civil or universal time, unless otherwise noted. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. If necessary, add 24 hours to the GCT before subtracting, and the result is your standard time on the day preceding the Greenwich date shown.

Astronomical Equipment and Supplies

The Teachers' Committee of the American Astronomical Society announces that through the kindness of H. W. Geromanos, manufacturer of the well-known astronomical equipment formerly supplied by the Eastern Science Supply Company, the tools, specifications, and manufacturing rights for the equipment have been made available without cost to the American Astronomical Society. Plans for taking advantage of this opportunity have not as yet crystallized. In the meantime, however, a few items such as coelospheres, ecliptic maps, Willson Hemisphere sets, and various co-ordinate papers, are available. For further information, address either Miss Leah B. Allen, Hood College, Frederick, Md., or Dr. J. Allen Hynek, McMillin Observatory, Ohio State University, Columbus 10, Ohio.

Unfortunately, the Teachers' Committee has as yet been unable to interest any company in the manufacture of celestial globes. There are, however, various sorts of celestial globes on the market which can in many cases meet teaching needs.

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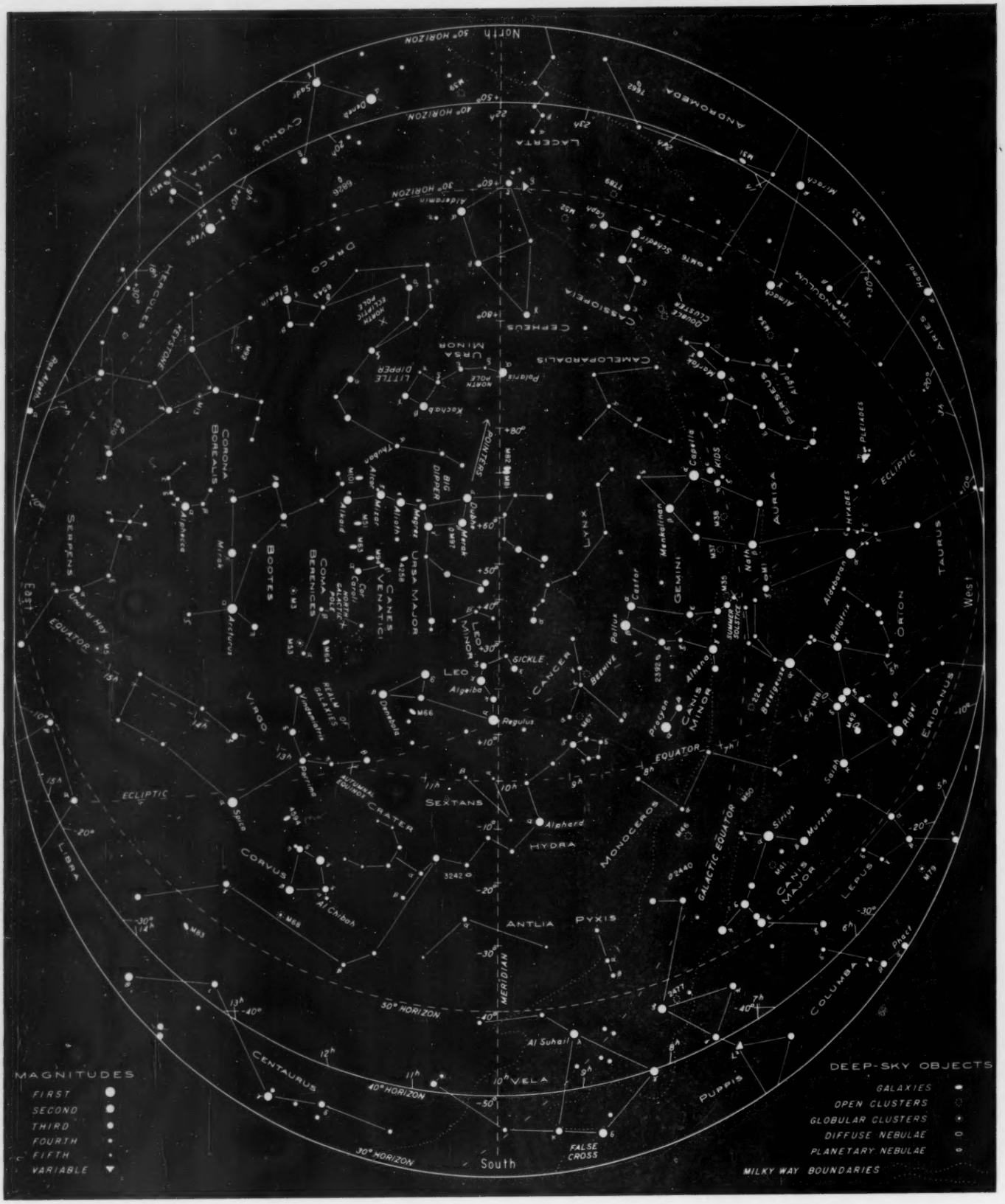


DEEP-SKY WONDERS

THE REACHES of Ursa Major contain many interesting nebulae but, because of lack of good guide stars, many amateurs are quite unfamiliar with the region. Webb, for example, lists no less than 13 objects within reach of small instruments here and only 16 objects for the nebula-famous Virgo area.

NGC 3587, M97, $11^h\ 9^m$, $+55°\ 34'$; the famous Owl nebula. Small telescopes show it only as a very faint hazy oval 3′ in diameter. The "owl" appearance usually is obvious only in photographs.

NGC 3031 and NGC 3034, M81 and M82, respectively, $9^h\ 51^m.5$, $+69°\ 18'$, with M82 half a degree north. A bright, brilliant "pair" of spirals easily found following 24 UMa. Seen better in a 13-inch reflector than in the 6-inch rich field. This pair of show objects should be familiar to every amateur.

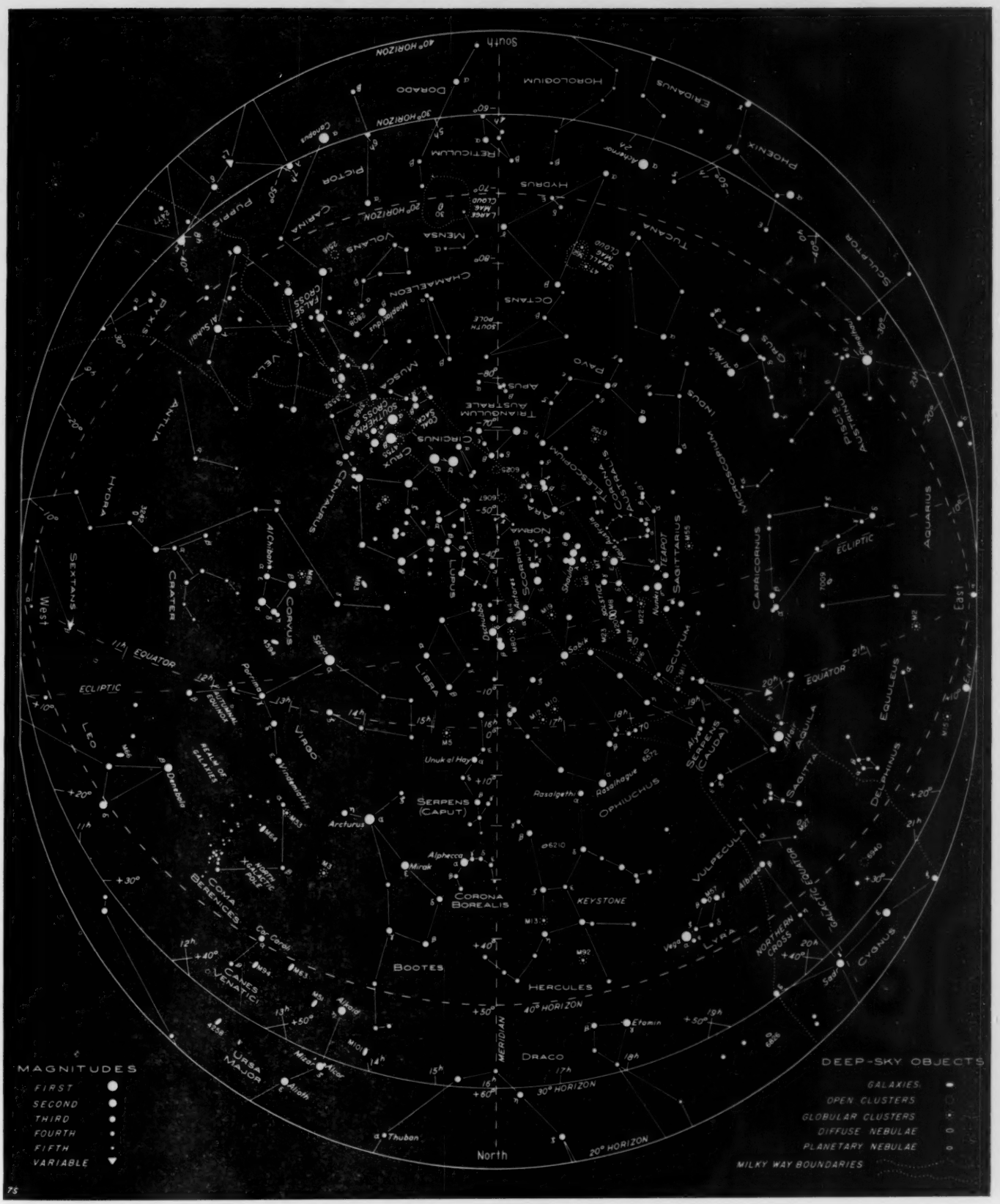
NGC 5322, 256[1], $13^h\ 48^m$, $+60°\ 25'$. A fairly bright spiral, 1.4′ x 1′.

WALTER SCOTT HOUSTON

STARS FOR APRIL

from latitudes 30° to 50° north, at 9 p.m. and 8 p.m., local time, on the 7th and 23rd of the month, respectively. The 40° north horizon is a solid circle; the others are circles, too, but dashed in part. When facing north, hold "North" at the bottom, and similarly for other directions.

CHART CORRECTION: Antlia is 10° too far north; NGC 6543, in Draco, should be at $17^h\ 58^m.6$, $+66°\ 38'$.



EVENING STARS FOR SOUTHERN OBSERVERS

THIS CHART is prepared for a basic latitude of 30° south, but it may be used conveniently by observers 20 degrees on either side of that parallel. These southern charts appear in alternate months, but always two or three months in advance, to allow time for transmission to observers in any part of the world. The sky is here shown as it appears on June 7th at 11 p.m., June 23rd at 10 p.m., July 7th and 23rd at 9 p.m. and 8 p.m., respectively. Times for other days vary similarly, four minutes earlier per day. These are local mean times which must be corrected for standard time differences. The 30° horizon is a solid circle; the other horizons are circles, too, those for 20° and 40° south being dashed in part. When facing south, hold "South" at the bottom, and similarly for other directions. Observers in the tropics may find north circumpolar stars on any of our northern star charts. For other charts in this series, see issues of June, 1945; alternate months from September, 1945, to July, 1946; and August, 1946, to the present.

Planetarium Notes

ADLER PLANETARIUM

900 E. Achsah Bond Drive, Chicago 5, Ill., Wabash 1428

SCHEDULE: Mondays through Saturdays, 11 a.m. and 3 p.m.; Sundays, 2:30 and 3:30 p.m.

STAFF: *Director,* Wagner Schlesinger. *Other lecturer:* Harry S. Everett.

April: THE SUN'S FAMILY. The motions of the planets and the conditions on their surfaces will be examined and the possible existence of life on them discussed.

May: OUR STAR, THE SUN.

BUHL PLANETARIUM

Federal and West Ohio Sts., Pittsburgh 12, Pa., Fairfax 4300

SCHEDULE: Mondays through Saturdays, 3 and 8:30 p.m.; Sundays and holidays, 3, 4, and 8:30 p.m.

STAFF: *Director,* Arthur L. Draper. *Other lecturers:* Nicholas E. Wagman, J. Frederick Kunze.

April: EASTER—THE AWAKENING. Under the stars of spring, the story of the Crucifixion and the Resurrection is told.

FORECASTING THE WEATHER. Simple weather signs we all can use in making our own weather predictions are discussed.

May: THE END OF THE WORLD.

FELS PLANETARIUM

20th St. at Benjamin Franklin Parkway, Philadelphia 3, Pa., Rittenhouse 3050

SCHEDULE: 3 and 8:30 p.m. daily except Mondays; also 2 p.m. on Saturdays, Sundays, and holidays. 11 a.m. Saturdays, Children's Hour (adults admitted).

STAFF: *Director,* Roy K. Marshall. *Other lecturers:* I. M. Levitt, William L. Fisher, Armand N. Spitz, Robert W. Neathery.

April: STARS AND ATOMS. Matter and energy on earth and in the universe, and the elements of X-rays, cosmic rays, radioactivity, fluorescence, and atomic energy will be shown.

May: ECLIPSES OF THE SUN.

GRIFFITH PLANETARIUM

P. O. Box 9866, Los Feliz Station, Los Angeles 27, Cal., Olympia 1191

SCHEDULE: Wednesday and Thursday at 8:30 p.m. Friday, Saturday, and Sunday at 3 and 8:30 p.m. Extra show on Sunday at 4:15 p.m.

STAFF: *Director,* Dinsmore Alter. *Other lecturers:* C. H. Cleminshaw, George W. Bunton.

April: THRU THE TELESCOPE. A demonstration and explanation of refracting and reflecting telescopes. Photographs are shown of telescopic celestial objects whose positions are pointed out in the planetarium sky.

May: THE FROZEN PLANETS.

HAYDEN PLANETARIUM

81st St. and Central Park West, New York 24, N. Y., Endicott 2-8500

SCHEDULE: Mondays through Fridays, 2, 3:30, and 8:30 p.m.; Saturdays, 11 a.m., 2, 3, 4, 5, and 8:30 p.m.; Sundays and holidays, 2, 3, 4, 5, and 8:30 p.m.

STAFF: *Honorary Curator,* Clyde Fisher. *Chairman and Curator,* Gordon A. Atwater. *Other lecturers:* Robert R. Coles, Catharine E. Barry, Shirley I. Gale, Edward H. Preston.

April: THE EASTER STAR PARADE. What constellations dominate the spring sky? Come and see them and learn how they change with the seasons.

May: ECLIPSES.

In Focus

THIS MONTH we reach the northern edge along the terminator of the last-quarter moon. The next three charts will run from south to north along the east side of the four charts which make up Plates X through XIII.

All named features in this region are indicated on the key chart, and descriptions of some of these appear below. Reference may also be made to Plates VI, VII, and XII, which appeared in July and August, 1946, and last month. Spellings follow the International Astronomical Union's **Named Lunar Formations,** and biographical information is from the British Astronomical Association's **Who's Who in the Moon.**

Alps. The appearance of this mountain range at this phase should be compared with the first-quarter moon appearance on Plate VII. Note that the Alpine Valley is not at all conspicuous under this illumination.

Anaxagoras, Anaximander, Anaximenes. Several early Greek philosophers are honored in this part of the moon, the names all assigned by Riccioli. The three formations are near the lunar limb and somewhat difficult to identify.

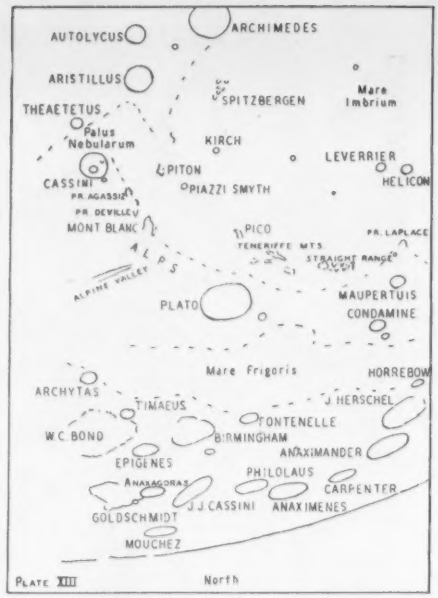
Cassini. Named for the discoverer of Cassini's division in Saturn's rings, the Italian astronomer who was the first director of Paris Observatory. The ringed plain has low and quite broad walls. A large crater and several smaller ones are in its interior.

J. J. Cassini. Jacques Cassini was the son of the Cassini mentioned above, and succeeded him as director of Paris Observatory, and was in turn succeeded by his son and grandson. He participated in the measurement of an arc of the meridian from Dunkirk to the Pyrenees. On the moon, J. J. Cassini has had a rather confused existence. Schroeter assigned it to a formation near the northern limb; some succeeding selenographers identified the formation, and others evidently could not. A number of recent maps, including those by Goodacre, Wilkins, and Andel, give the name to an irregular plain between Fontenelle and Philolaus — this comparatively smooth-floored area can be noted on the back cover this month. This information is from the I.A.U. catalogue, which goes on to say, "As neither of these formations seems suitable for a name, that of J. J. Cassini is here transferred to a smaller but well bordered crater or valley outside the southwest wall of Philolaus D."

Mare Frigoris, the Sea of Cold, near the north pole of the moon, appears on this chart nearly in its entirety.

Palus Nebularum is the Misty Marsh.

Piazzi Smyth. This small, distinct crater was named for the son of Admiral William Henry Smyth, for whom Mare Smythii was called. The son, Charles Piazzi Smyth, was born in Naples and named after the astronomer Piazzi, under whom his father had studied. Piazzi Smyth became Astronomer Royal for Scotland, and worked in spectroscopy. He died in 1900. His "astronomer's experiment," **Who's Who in the Moon** relates, was the first of its kind. He spent months on the Peak of Teneriffe making telescopic observations to test the advantages of high altitudes. This work interested all astronomers, and was Birt's reason for commemorating his name on the moon.



Pico. This isolated mountain, 7,000 to 9,000 feet high, and the nearby Piton are bright and conspicuous, rising directly from the plain. They are named for mountains in the Teneriffe Range, in recognition of the expedition there led by Piazzi Smyth.

Piton. See Pico, above.

Plato. This walled formation, about 60 miles across, is one of the best observed regions on the moon. Its walls rise to between 3,000 and 5,000 feet above the floor, which has some craterlets on it visible only in large instruments. The formation was named by Riccioli for the famous Greek philosopher (c. 427-347 B.C.).

Straight Range. Named for its appearance, this compact line of mountains just inside the northern edge of Mare Imbrium is about 45 miles long.

Teneriffe Mountains. This range is near the Straight Range, and seems to consist of four individual mountain masses. They were named in commemoration of the expedition of Piazzi Smyth to the Teneriffe Mountains in the Canary Islands. (See Piazzi Smyth and Pico, above.)

MINIMA OF ALGOL

April 1, 9:59; 4, 6:49; 7, 3:38; 10, 0:27; 12, 21:16; 15, 18:05; 18, 14:54; 21, 11:43; 24, 8:32; 27, 5:22; 30, 2:11. May 2, 23:00; 5, 19:49.

The INDEX for Volume V

is now ready for mailing. Its style is similar to previous indexes, including title page; author, title, subject, and topic references. Send 35 cents in stamps or coin, or include it with your subscription renewal check or money order. Indexes to earlier volumes are also available.

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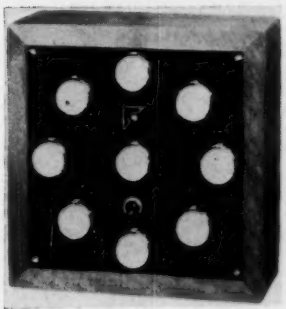

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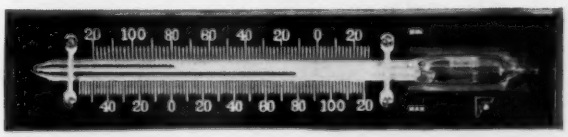

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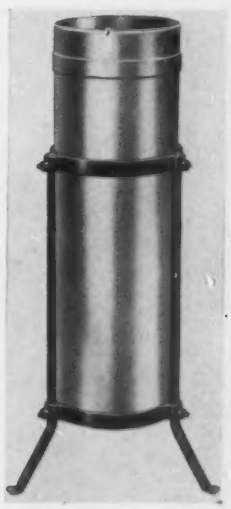

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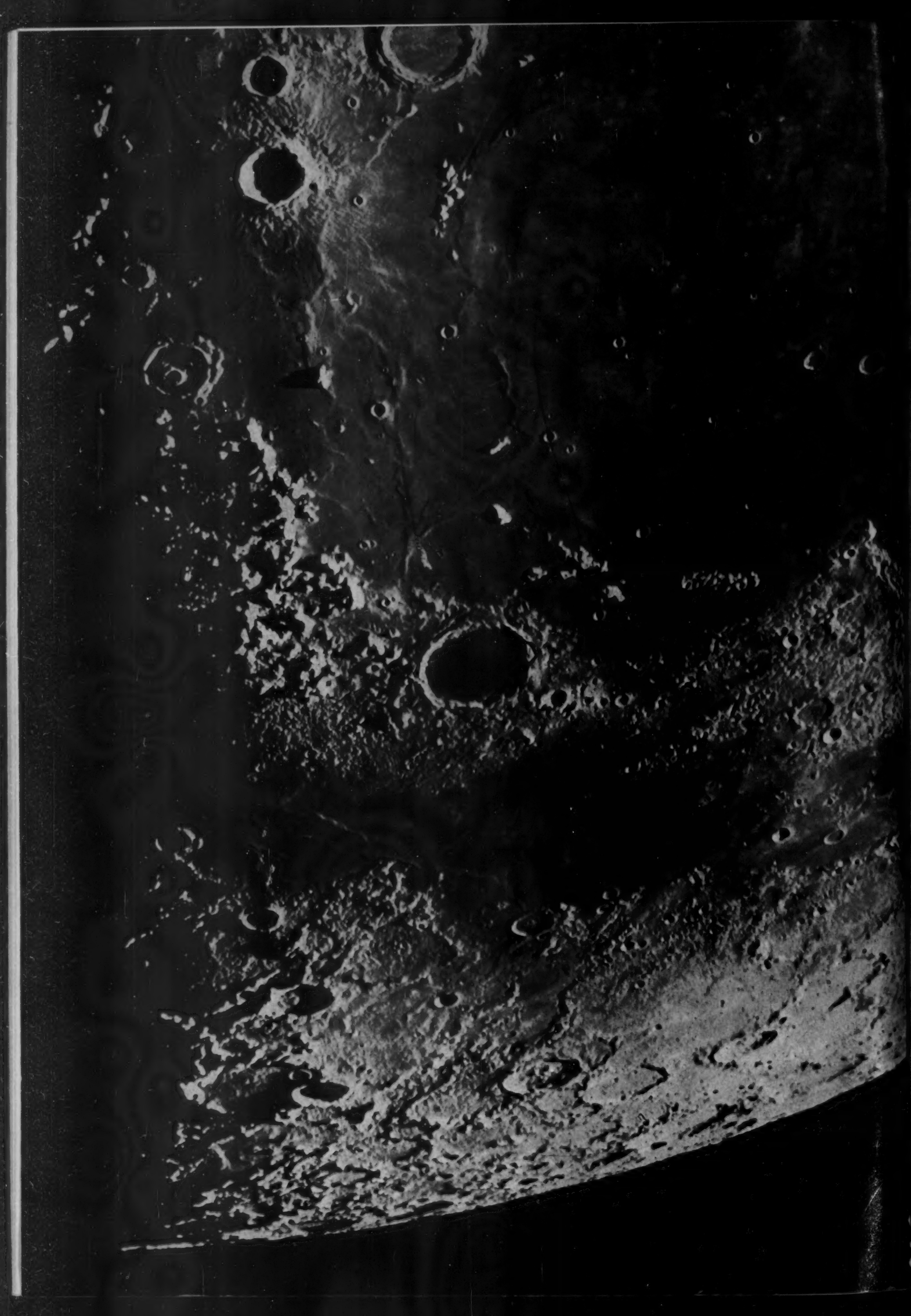
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